KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, SEPT. 12, 1884.

CONTENTS OF No. 150.

	PAGE
Dickens's Story Left Half Told. By Thomas Foster	209
The Entomology of a Pond. (*Illus.*) By E. A. Butler	210
The Chemistry of Cookery. XLII. Stimulants and Condiments. By W. Mattieu Williams	212
Ships' Lights	213
The Earth's Shape and Motions. (*Illus.*) By Richard A. Proctor	214
British Seaside Resorts. IV. By Percy Russell	215
Notes on Coal. By Richard A. Proctor	216
Novel Tricycles. (*Illus.*) By John Browning	217
The International Health Exhibition. XV. (*Illus.*)	218
Other Worlds than Ours. By M. de Fontenelle. With Notes by Richard A. Proctor	220
Editorial Gossip	221
Reviews	222
Face of the Sky. By F.R.A.S.	222
Correspondence:—Shooting Stars and Meteorites, &c.	224
Our Whist Column	227
Our Chess Column	228

DICKENS'S STORY LEFT HALF TOLD.

A QUASI SCIENTIFIC INQUIRY INTO

THE MYSTERY OF EDWIN DROOD.

By THOMAS FOSTER.

IN reply to H. E., I note that the article on "The Mystery of Edwin Drood," though republished in the KNOWLEDGE LIBRARY ("Leisure Readings") did not originally appear in KNOWLEDGE but in the *Belgravia Magazine*, about five years since: I do not recollect the exact date. In "Leisure Readings" the article is longer by about one-fourth than as it first appeared.* Let me further explain that in speaking of the article in the *Cornhill Magazine* as "rather feeble," I was thinking only of the way in which the writer presents as a mystery which Dickens had been careful to conceal, precisely that which Dickens had been most careful to suggest. In this sense, also, H. E. appeared to me decidedly to place himself in the rank of those "commonplace readers" whose ways Dickens understood so well. Dickens himself, though he may have led Mr. Fildes to think that only "a keen reader" could "ever find out who and what was Mr. Datchery," had as certainly conveyed to Miss Hogarth his fear lest keen readers would find out the real meaning of what he called "the Datchery assumption," and that with that they would recognise the course along which the story was to have advanced towards its end. And Dickens himself, while he knew how much or how little he had consciously left open to the keener among his readers, did *not* know how much he unconsciously left open to those whose ears could take in the music of his prose poetry. I venture to say that to any one possessing this power the general purport of the plot of all Dickens's later novels was made clearer by unconscious suggestions than by any of those indications which Dickens consciously left open to his keener followers.

Before entering on the consideration of what appears to me most obviously to have been Dickens's purpose and meaning in his last story, let me invite H. E.'s attention to the significance of the passage which he quotes from the article "How Edwin Drood was illustrated," in the *Century Magazine* for February, 1884. It disposes in the first place, utterly, of H. E.'s own views, if he admits that the central crime was "never intended by the author to be a mystery,"—which is precisely my contention. And certainly if the true interpretation of Mr. Datchery is that "he is some detective," then no great keenness would be required on the reader's part, for Dickens tells us as plainly as possible that Datchery is *some* detective, though assuredly not an ordinary detective, as H. E. opines. If the character of Datchery is "an assumption," and Dickens spoke of it as such to Mr. Forster and to Miss Hogarth, then apart from all other evidence Datchery *cannot* be a professional detective; and if the "finding out who and what Mr. Datchery was" be important to the elucidation of the mystery, Datchery cannot be Buzzard, the only other character in the story who could *possibly* have assumed the part, except Edwin Drood himself. H. E., I see, rejects as I do the idea that Datchery is Buzzard; and I may remark on this point that any one who could suppose for a moment that Buzzard is Datchery would show such an utter want of appreciation of Dickens's manner and methods, that it would be idle to deal with him by reasoning. Datchery and Buzzard are made by Dickens to be altogether different *men:* Datchery and Drood are made by him to be as unlike as possible in all outside features; and as the great trial through which he had passed would necessarily have changed Drood much in character, Dickens has endeavoured to make Datchery and Drood unlike in manner; but they are as obviously the same *men*, as Hamlet after he has seen his father's ghost is the same as the Hamlet of earlier scenes. There is a quaint humour in Datchery which is seen in Drood and Drood only of all the characters of the story. There is a kindness to old folk and to children, and a power of understanding their ways, which is shown only in Drood (and is in words attributed to him, besides being indicated in action); and lastly there is a wistfulness associated with Datchery's humorous manner which Drood alone of all the characters in the opening part of the story had shown. So that Datchery being by Dickens's own statement an "assumption," could be no other than Drood, even if Dickens had said in so many words that Drood was dead (which in his earlier manner, he would not have hesitated to do, explaining afterwards how that meant only that he was dead in men's thoughts). But it will be noticed that Drood is never once spoken of as dead, either by the author, or by Grewgious, or by Rosa. We have passages suggestive of death, both before and after the attempted murder. We are told that "he never called Rosa Pussy more, never again." Again, after we are told he purposed never to return to Cloisterham, come the words, "Poor youth! poor youth!" and so forth, just as Dickens says that "no such being as Richard Doubledick remained in the world of consciousness," that Vendale's "heart had ceased to beat," and so forth. He does all he can to suggest that the murder has been successful, and lets us know, in fact, that Jasper is full sure it has been successful (and surely Jasper ought to know); but he had been just as careful to impress on his readers the belief that Jonas Chuzzlewit had been successful in murdering Anthony Chuzzlewit, and he lets us know that Jonas was full sure he had been successful; yet neither in one case nor in the other had the murderer's plot succeeded, as he imagined.

With regard to the terrible grief which H. E. considers that Drood unnecessarily caused Rosa, he will find if he reads the story attentively the most remarkable avoidance of any words suggestive that Rosa suffered such grief as she

* It will be found that the greater part of the reasoning presented in this and the following papers on the subject of Dickens's last story is independent of the evidence—itself I think convincing—advanced in the above-mentioned article.

XUM

would certainly have felt had Drood been really dead. There is not a word implying that she thinks Drood is dead. And this is so much the stranger that Dickens draws so close, again and again, to occasions for speaking of Rosa's sorrow for Drood. She speaks of Drood to Jasper in the past tense; but that of course she would be bound to do. We hear of her sorrow for Drood in connection with her growing love for Tartar,—and this would be natural whether she thought Drood dead or alive, (but much more natural if, supposing Drood alive, she was sad at the thought that he might still love her though their engagement had been broken off.)—T. F.

But now for what seems to me most obviously to be the course of the story up to the time when its author's pen fell from his hand, and (in general outline only, of course) its intended course thereafter.

Before the attempted murder, the points to be specially noted are these :—

First, the way in which Jasper has arranged for the disposal of Drood's body after the murder. We see him arranging a meeting with Japsea and Durdles, in such a way that all he may do in the way of using Durdles' knowledge may seem to have been suggested by Japsea. (The three wine-glasses, and what is said of them, should be specially noticed.) At this meeting again Jasper cleverly uses his musical knowledge to obtain a means of identifying the various keys carried by Durdles,—a means which neither Durdles nor Japsea would suspect, but Durdles notes (without at the time understanding) what he is doing. He repeats his tone-test soon after, in company with Durdles only. Later, in the "surely unaccountable expedition," we see how Jasper applies the knowledge thus obtained. He drugs the wine which he knows Durdles will drain to the last drop, and when Durdles sinks to sleep, he takes the keys, clinks them again, and in the long hours at his disposal (for the "murmur of the tide of life" is still heard when they enter the Precincts, and it is two o'clock when Durdles at length wakes) he takes impressions of the keys, collects quicklime within the Japsea tomb, and prepares generally for the crime he has planned. That he has been outside is shown, after the author's manner, by his wrath with the Deputy (wrath so fierce that "he seemed like a devil") because "he followed us here to-night" and "has been prowling near us ever since," which would not have mattered had Jasper remained inside the crypt while Durdles slept.

Secondly, we are to note the sadness felt by Drood after his parting with Rosa. Much of the significance of Datchery's conduct later is lost if we overlook this feeling on Drood's part. That it had an important bearing on the later progress of the story, and was meant to be most carefully noted by the more thoughtful and understanding readers, is obvious to all who know Dickens's manner. Follow what Dickens says here, noting that his first words about Drood in the chapter most significantly headed WHEN WILL THESE THREE MEET AGAIN? (showing clearly that Neville, Drood, and Jasper *were* to meet again): "Edwin Drood passed a solitary day. Something of deeper moment than he had thought, has gone out of his life; and in the silence of his own chamber he wept for it last night . . . the pretty little affectionate creature, so much firmer and wiser than he had supposed occupies the stronghold of his mind. It is with some misgiving of his own unworthiness that he thinks of her, and of what they might have been to one another, if he had been more in earnest some time ago; if he had set a higher value on her; if instead of accepting his lot in life as an inheritance of course, he had studied the right way to its appreciation and enhancement." . . . . Then later,—"He strolls about and about, to pass the time. . . . . It somehow happens that Cloisterham seems reproachful to him to-day; has fault to find with him, as if he had not used it well; but is far more pensive with him than angry. His wonted carelessness is replaced by a wistful looking at and dwelling upon, all the old landmarks. He will soon be far away, and may never see them again, he thinks. Poor youth! Poor youth!"—Later yet,—"Always kindly, but moved to be unusually kind this evening, and having bestowed kind words on most of the children and aged people he has met, he bends down" to the old opium eater, and speaks to her. The conversation should be most carefully followed and compared with the later conversation between the same old woman and Datchery. I could as readily doubt that the same person speaks to her on both these occasions, as I could doubt whether the Moonlight Sonata and the Sonata Pathetique came from the same composer. Apart, however, from the words and manner of Drood and Datchery, consider what is said about them. Compare the words quoted above with these :—"Mr. Datchery pauses as if he were falling into a brown study and couldn't bear to part with"—something—"but he bestows" his gift on the old woman (who is then so dull as to imagine that it is of *this* he is thinking?), "as if he were abstracting his mind from the sacrifice. . . . . John Jasper's lamp is kindled, and his lighthouse is shining when Mr. Datchery returns alone towards it. As mariners, on a dangerous voyage, approaching an iron-bound coast, may look along the beams of the warning light to the haven lying beyond it that may never be reached, so Mr. Datchery's wistful gaze is directed to this beacon, and beyond." Compare the two following few words alone, if the music of each full passage is not easily caught :—

Of Drood, we read,—"*His wonted carelessness is replaced by a wistful looking at and dwelling upon all the old landmarks: he will soon be far away, and may never see them again, he thinks.*"

Of Datchery,—"*As mariners look along the beams of the warning light to the haven lying beyond it that may never be reached, his wistful gaze is directed to this beacon and beyond.*"

That this resemblance, or rather this oneness of tone should have escaped notice I can understand; but that any one whose attention has once been directed to it can fail to see that Drood and Datchery are one, seems to me scarce conceivable. I certainly cannot imagine how any one could suppose the later words applied to a detective employed by Grewgious, or to the stupid and selfish Buzzard.

(*To be continued.*)

THE ENTOMOLOGY OF A POND.

By E. A. Butler.

THE BOTTOM (*continued*).

THE water scorpions are aquatic during the whole of their lives, but the insects we have now to consider pass only their earlier stages in the water, being inhabitants of the air when they have reached the perfect, or imago, form; indeed, the bottom of the pond is, as a rule, much more the theatre of larval than of imaginal life. As we have before intimated, beetles and bugs are almost the only kinds of insects that are strictly aquatic when adult.

We will first take the larvæ of the dragon-flies. The perfect insects, which are sometimes also called horse-

stingers, and in Scotland go by the name of "devil's darning-needles," and in America by that of "mosquito hawks," will detain us later on, when we speak of the fauna of the aërial regions just above the pond. Suffice it here to say, that they have four large glassy-looking wings, reticulated with a multitude of nervures, and usually a long, slender body, which has suggested to our Highland brethren the diabolical connection above mentioned. For brilliancy of coloration they easily take a prominent position in the insect world; but their beauty pertains wholly to the adult form. In their aquatic stages they are the dingiest of the dingy, and in many cases are hideously ugly. When you have brought yourself to perform the disagreeable task of hauling out of a dirty pond a mass of slimy weeds and fetid mud, and have deposited it on the bank, you see the mass here and there heaving with the struggles of these ugly brutes as they gradually work their way into daylight and drag their grimy bodies out of the tenacious and unsavoury mess. What a contrast between this sordid life and the gay and brilliant existence of the shiny-winged adult, as it dashes about, glistening in the sunbeams! There are two principal types of these larvæ; one a broad, thickset, clumsy creature, which yields the larger and stouter-bodied dragon-flies, the other slender and carrying some leaf-like appendages at the tail, the immature condition of the most slender and graceful members of the group. Taking first the former of these (Fig. 1), we see a creature with six

Fig. 1.—Larva of Dragon Fly.

straggling legs, which, sprawling out at the sides, would, were it not for their number, be strongly suggestive of affinities to the spider class. The head, when viewed from above, is surprisingly like that of a kitten, the prominent ears of the latter being represented by the equally prominent eyes of the insect; the two short antennæ, too, are suggestive of the kitten's whiskers. Then comes the thorax, with curious ridges like rough bark, and carrying the six sprawling legs and the rudimentary wings, and then the abdomen, broadest a little behind the middle, and exhibiting, especially in its hinder part, periodical contractions and dilatations, the length being lessened at the expense of the breadth. This motion, as might be expected, is a respiratory one. The breathing is performed in a manner as wonderful as it is unique. It is most marvellous what a variety of contrivances there are to enable aquatic insects to perform this important function; we have already referred to the diving-bell arrangement of the water-beetles, the anal spiracle of some of their larvæ, and the lateral leaf-like appendages of others, the long tail-filaments of the water scorpions, and the feathery stars and tubes of the gnat larvæ and pupæ, and now we come to an arrangement totally distinct from all of these. At the extremity of the body there are some stout, spine-like processes, surrounding the terminal orifice of the digestive tube, which is guarded by a valvular apparatus. By muscular effort these spines, which are movable at their base, can be opened out like the parts of a wire egg-whisk, the capacity of the abdomen being at the same time increased; the valves are thus opened, and water rushes in and fills the terminal part of the intestinal canal, and after remaining there a short time, is forcibly ejected by a reversal of these operations. The lining of the last part of the intestine is produced into six double series of folds, whereby its surface is enormously increased. In the interior of these thin folds, great numbers of minute tracheal tubes are distributed. The water, of course, as usual, contains air dissolved in it; and, as it passes over these tracheal tubes, the fresh air with which it is charged can be exchanged for the contaminated supply contained in the tubes, by simple transfusion of the gases through the thin walls of these. As soon as this has been effected, the now useless water is got rid of in the manner above described, but its expulsion frequently serves the additional purpose of effecting locomotion. When the insect is calm and undisturbed, the water is passed out gently, but should it be disturbed or alarmed, a forcible ejection of the liquid follows, and just as a rocket mounts in the air while the gases into which its contents are being transformed by the process of combustion, rush out in the other direction, so the larval dragon-fly is shot swiftly forward as the jet passes out from behind. The jet can be readily observed: if there are particles of matter in suspension in the water, their movements as they are carried along with the stream make the current perceptible; or if the creatures are in a shallow vessel with only just enough water to cover them, the surface will be seen to be violently disturbed at every expiration. The force with which the water can be projected is quite surprising; the most astonishing record comes from over the sea. A lady states in the *American Naturalist* that a larva of a large species, when disturbed, sent out a fine stream of water to the distance of from two to three feet, and continued doing so indefinitely!

These curious beings then progress by a series of jerks or leaps, though, of course, they can crawl as well. Some kinds while jerking themselves forward, assist their efforts by a sharp backward stroke of the legs (though these are not modified for swimming purposes), and finish the stroke by bringing the legs close alongside the body, an action by no means inelegant.

The more slender kinds have an elongated body, which they can move pretty vigorously from side to side as a fish does its tail. They have also three external leaf-like appendages at the tail, which are thin, and are each supplied with a tracheal tube and its branches, the exchange of gases taking place here externally in the same way as in the others internally. These caudal leaves, too, are used to assist locomotion.

But we have yet to consider one of the most remarkable peculiarities of these creatures. If we take a front view of the head, we see the lower part of the face rounded and smooth, with a vertical zigzag line down the centre, and showing no traces of great jaws such as one would expect in so voracious an insect. This is simply because they are concealed by a very curious modification of that part of the mouth which, in insects generally, is called the labium, or lower lip. To examine this structure it is best to take a freshly-killed specimen; this is easily obtained by plunging the creature into *boiling* water, which produces instantaneous death. By aid of a pin or needle we can now easily open out the "mask," as it is called (Fig. 2), and when fully extended, we see that it looks something like a broad-handled ladle, attached by the handle underneath the head. It consists of several joints, the basal one of which is attached to the lower part of the head,

XUM

or, as we might say, under the chin. Succeeding this is another piece, at the outer angles of which are attached two curved triangular jaw-like pieces articulated to it by one of their angles, and capable of folding inwards till their saw-like edges exactly meet, when the front part of the apparatus forms the bowl of the ladle. When closed, the basal joint is bent backwards, showing as a bluntly-pointed projection, reaching to the base of the

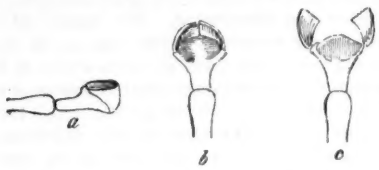


Fig. 2.—Mask of Dragon Fly. *a.* Side View. *b.* Viewed from Above. *c.* The Same, with Jaws Open.

second pair of legs; the next piece is folded back upon this, and the bowl-like part is thus brought close up to the face, which fits into the hollow. When the mask is extended, the real jaws are seen beneath in the usual position. The mask is used somewhat like the raptorial legs of the water-scorpions—viz., to seize a passing insect at a little distance. To accomplish this, it is very rapidly unfolded, darted out with unerring aim, and brought back again into position, thus holding the prey close up to the true jaws.

Dragon-flies do not alter much during their earlier stages. The traces of wings soon appear, even after the first moult or two. When a moult is about to take place, the creature fixes its claws into some support to obtain leverage for its coming struggle, and then, by strong muscular effort, the back of the thorax is split, and the insect crawls out of its case. The cast skins may frequently be seen floating about in ponds. The insects are very voracious, and when other food fails, will not scruple to adopt cannibalism.

(To be continued.)

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

XLII.—STIMULANTS AND CONDIMENTS.

BEFORE proceeding further, I must fulfil the promise made in No. 39 to report the results of my repetition of the Indian process of preparing *samp*. I soaked some ordinary Indian corn in a solution of carbonate of potash, exceeding the ten or twelve hours specified by Count Rumford. The external coat was not removed even after two days' soaking, but the corns were much swollen and softened. I suspect that this difference is due to the condition of the corn which is imported here. It is fully ripened, dried, and hardened, while that used by the Indians was probably fresh gathered, barely ripe, and much softer.

Mr. Gaubert (No. 1,373, page 185) asks me whether I think that tea taken in moderation (say two cups in the evening) does any mischief. If he carefully reads No. 40 he will find the answer already given before his question was asked. He offers to relinquish the habit, in spite of the pang, "on the advice of so eminent an authority" as myself. I hope that he will not be so weak as to accept my authority or any other on a question which can easily be answered by common-sense and simple direct experiment. There are cases in which we are compelled to lean on authority, but this is not one of them, and he will see, by re-perusing what I have written on the subject, that I have repudiated mere authority, and appealed to facts that are open to all.

I will reply further to Mr. Gaubert, as in doing so I shall be also replying to a multitude of others, his case being typical. Let any of these repeat the experiment that I have made. After establishing the habit of taking tea at a particular hour, suddenly relinquish it altogether. The result will be more or less unpleasant, in some cases seriously so. My symptoms were a dull headache and intellectual sluggishness during the remainder of the day—and if compelled to do any brain-work, such as lecturing or writing, I did it badly. This, as I have already said, is the diseased condition induced by the habit. These symptoms vary with the amount of the customary indulgence and the temperament of the individual. A rough, lumbering, insensible navvy may drink a quart or two of tea, or a few gallons of beer, or several quarterns of gin, with but small results of any kind. I know an omnibus-driver who makes seven double journeys daily, and his "reglars" are half-a-quartern of gin at each terminus —*i.e.*, $1\frac{3}{4}$ pints daily, exclusive of extras. This would render most men helplessly drunk, but he is never drunk, and drives well and safely.

Assuming, then, that the experimenter has taken sufficient daily tea to have a sensible effect, he will suffer on leaving it off. Let him persevere in the discontinuance, in spite of brain languor and dull headache. He will find that day by day the languor will diminish, and in the course of time (about a fortnight or three weeks in any case) he will be weaned. He will retain from morning to night the full, free, and steady use of all his faculties; will get through his day's work without any fluctuation of working ability (provided, of course, no other stimulant is used). Instead of his best faculties being dependent on a drug for their awakening, he will be in the condition of true manhood—*i.e.*, able to do his best in any direction of effort, simply in reply to moral demand; able to do whatever is right and advantageous, simply because his reason shows that it is so. The sense of duty is to such a free man the only stimulus demanded for calling forth his uttermost energies.

If he again returns to his habitual tea, he will again be reduced to more or less of dependence upon it. This condition of dependence is a state of disease precisely analogous to that which is induced by opium and other drugs that operate by temporary abnormal cerebral exaltation. The pleasurable sensations enjoyed by the opium-eater or smoker or morphia injector are more intense than those of the tea-drinker. Mr. Gaubert tells us that he enjoys his cup "immensely." The gin-drinker enjoys his half-quartern "immensely," as anybody may see by "standing treat" and watching the result. The victim of opium has enjoyment still more immense, and in every case the magnitude of the mischief is measurable by the immensity of the enjoyment.

Again I say that I am not denouncing the proper use of any of these things. There are occasions when artificial stimulants or sedatives cautiously used are most desirable. My condemnation is applied to their *habitual* use, and the physical and moral degradation involved in the slavish dependence upon any sort of drug, especially when the drug operates most powerfully on the brain. To the brain-worker tea is worse than alcohol, because it exaggerates his special liability to overstrain. I can detect by physiognomical indications the habitually-excessive tea-drinker as readily as I can detect the physiognomy of the opium-victim, as may anybody else who chooses to make careful observations.

XUM

I must not leave this subject without a word or two in reference to a widely prevailing and very mischievous fallacy. Many argue and actually believe that because a given drug has great efficiency in curing disease, it must do good if taken under ordinary conditions of health.

No high authorities are demanded for the refutation of this. A little common sense properly used is quite sufficient. It is evident that a medicine, properly so-called, is something which is capable of producing a disturbing or alterative effect on the body generally or some particular organ. The skill of the physician consists in so applying this disturbing agency as to produce an alteration of the state of disease, a direct conversion of the state of disease to a state of health, if possible (which is rarely the case), or more usually the conversion of one state of disease into another of milder character. But, when we are in a state of sound health, any such disturbance or alteration must be a change for the worse, must throw us out of health to an extent proportionate to the potency of the drug.

I might illustrate this by a multitude of familiar examples, but they would carry me too far away from my proper subject. There is, however, one class of such remedies which are directly connected with the chemistry of cookery. I refer to the condiments that act as "tonics," excluding common salt, which is an article of food, though often miscalled a condiment. It is food simply because it supplies the blood with one of its normal and necessary constituents, chloride of sodium, without which we cannot live. A certain quantity of it exists in most of our ordinary food, but not always sufficient.

Cayenne pepper may be selected as a typical example of a condiment properly so called. Mustard is a food and condiment combined; this is the case with some others. Curry powders are mixtures of very potent condiments with more or less of farinaceous materials, and sulphur compounds, which, like the oil of mustard, of onions, garlic, &c., may have a certain amount of nutritive value.

The mere condiment is a stimulating drug that does its work directly upon the inner lining of the stomach, by exciting it to increased and abnormal activity. A dyspeptic may obtain immediate relief by using cayenne pepper. Among the advertised patent medicines is a pill bearing the very ominous name of its compounder, the active constituent of which is cayenne. Great relief and temporary comfort is commonly obtained by using it as a "dinner pill." If thus used only as a temporary remedy for an acute and temporary, or exceptional, attack of indigestion all is well, but the cayenne, whether taken in pills or dusted over the food or stewed with it in curries or any otherwise, is one of the most cruel of slow poisons when taken *habitually*. Thousands of poor wretches are crawling miserably towards their graves, the victims of the multitude of maladies of both mind and body that are connected with chronic, incurable dyspepsia, all brought about by the habitual use of cayenne and its condimental cousins.

The usual history of these victims is that they began by over-feeding, took the condiment to force the stomach to do more than its healthful amount of work, using but a little at first. Then the stomach became tolerant of this little, and demanded more; then more, and more, and more, until at last inflammation, ulceration, torpidity, and finally the death of the digestive powers, accompanied with all that long train of miseries to which I have referred. India is their special fatherland. Englishmen, accustomed to an active life at home, and a climate demanding much food fuel for the maintenance of animal heat, go to India, crammed, may be, with Latin, but ignorant of the laws of health; cheap servants promote indolence, tropical heat diminishes respiratory oxidation, and the appetite naturally fails. Instead of understanding this failure as an admonition to take smaller quantities of food, or food of less nutritive value, they regard it as a symptom of ill-health, and take curries, bitter ale, and other tonics or appetising condiments, which, however mischievous in England, are far more so there.

I know several men who have lived rationally in India, and they all agree that the climate is especially favourable to longevity, provided bitter beer, and all other alcoholic drinks, all peppery condiments, and flesh foods are avoided. The most remarkable example of vigorous old age I have ever met was a retired colonel eighty-two years of age, who had risen from the ranks, and had been fifty-five years in India without furlough; drank no alcohol during that period; was a vegetarian in India, though not so in his native land. I guessed his age to be somewhere about sixty. He was a Scotchman, and an ardent student of the works of both George and Dr. Andrew Combe.

While still seasonable I add by way of postscript a receipt for a dish lately invented by my wife. It is vegetable marrow *au gratin*, prepared by simply boiling the vegetable as usual, slicing it, placing the slices in a dish, covering them with grated cheese, and then browning slightly in an oven or before the fire, as in preparing the well-known "cauliflower *au gratin*." I have modified this (with improvement, I believe) by mashing the boiled marrow and stirring the grated cheese into the midst of it whilst as hot as possible; or, better still, by adding a little milk, a pinch of bicarbonate of potash, mixing with the cheese, and then returning this purée to the saucepan, heating and stirring it there for a few minutes to effect the complete solution of the cheese. This dish is not so pretty as that *au gratin* browned in orthodox fashion, but is more digestible.

SHIPS' LIGHTS.

THE following extract from the New Regulations for Preventing Collisions at Sea, which came into force on the 1st inst. (and for which we are indebted to Captain D. Forbes, of Southampton), may be read in connection with letter 1375 (p. 185):—

A ship, whether a steam ship or a sailing ship, employed in laying or in picking up a telegraph cable, shall at night carry in the same position as the white light which steam ships are required to carry, and, if a steam ship, in place of that light, three lights in globular lanterns, each not less than 10-in. in diameter, in a vertical line over one another, not less than 6 ft. apart; the highest and lowest of these lights shall be red, and the middle light shall be white, and they shall be of such a character that the red lights shall be visible at the same distance as the white light. By day she shall carry in a vertical line, one over the other, not less than 6 ft. apart, in front of but not lower than her foremast head, three shapes, not less than 2 ft. in diameter, of which the top and bottom shall be globular in shape and red in colour, and the middle-one diamond in shape and white.

The following portion of this article applies only to fishing vessels and boats when in the sea off the coast of Europe lying north of Cape Finisterre:—

(*a*) All fishing vessels and fishing boats of 20 tons net registered tonnage, or upwards, when under way and when not required by the following regulations in this article to carry and show the lights therein named, shall carry and show the same lights as other vessels under way.

(*b*) All vessels when engaged in fishing with drift nets shall exhibit two white lights from any part of the vessel where they can be best seen. Such lights shall be placed so that

XUM

the vertical distance between shall be not less than 6 ft. and not more than 10 ft.; and so that the horizontal distance between them measured in a line with the keel of the vessel shall be not less than 5 ft. and not more than 10 ft. The lowest of these two lights shall be the more forward, and both of them shall be of such a character, and contained in lanterns of such construction, as to show all round the horizon, on a dark night with a clear atmosphere, for a distance of not less than three miles.

(*c*) A vessel employed in line fishing with her lines out shall carry the same lights as a vessel when engaged in fishing with drift nets.

(*d*) If a vessel when fishing becomes stationary in consequence of her gear getting fast to a rock or other obstruction, she shall show the light and make the fog signal for a vessel at anchor.

(*e*) Fishing vessels and open boats may at any time use a flare-up in addition to the lights which they are by this Article required to carry and show. All flare-up lights exhibited by a vessel when trawling, dredging, or fishing with any kind of drag net, shall be shown at the after part of the vessel, excepting that, if the vessel is hanging by the stern to her trawl, dredge, or drag net, they shall be exhibited from the bow.

(*f*) Every fishing vessel and every open boat when at anchor between sunset and sunrise shall exhibit a white light visible all round the horizon at a distance of at least one mile.

(*g*) In fog, mist, or falling snow, a drift net vessel attached to her nets, and a vessel when trawling, dredging, or fishing with any kind of drag net, and a vessel employed in line fishing with her lines out, shall, at intervals of not more than two minutes, make a blast with her fog horn and ring her bell alternately.

A ship which is being overtaken by another shall show from her stern to such last-mentioned ship a white light or a flare-up light.

An "Officer of the Watch," writing to the *Times*, says:—

"In the June number of the *Nautical Magazine*, a letter appeared pointing out the necessity of screening all lights about the decks of ships at sea, except those which are required by the Board of Trade for the prevention of collision, and stating that the Board of Trade surveyors would do well to see that the proper means were at hand for so doing, as the chances of collision would be thereby diminished. On my last homeward passage, in the Bay of Biscay, a large outward-bound steamer was passed between 8 and 10 o'clock one night on our starboard side, and so great was the glare from the lights in her deck saloon (which I took to be lighted by electricity) that her green light was completely outshone, and could not be seen, though well within the range of visibility. I should venture to say that, from the size and speed of the ship, she belonged to one of the finest lines of steamers running, and it seems to me rather strange that those in authority in the managing departments of large steamship companies are not alive to what might be a very fruitful source of collision. Had dense smoke obscured the masthead light of this steamer, the direction in which she was travelling would have been left to conjecture."

THE EARTH'S SHAPE AND MOTIONS.

By Richard A. Proctor.

CHAPTER IV. (*continued from page* 196.)

OF all parts of the earth's surface the Equator is that where the evidences of the real nature of the earth's relations to surrounding space are most convincing. I think it probable that to many of my readers an account of the nature of the diurnal rotation of the heavens, as witnessed from the Equator, may be at once new and interesting.

The north pole, as I have mentioned, has sunk to the horizon when our voyager reaches the equator. Another pole, whose existence had hitherto only been indicated, is now raised from beneath the southern horizon, and lies directly opposite the northern pole. Thus a circle carried from the east point of the horizon through the point vertically overhead, and so down to the western horizon, divides the visible heavens into a northern and a southern half, the motions within one half corresponding exactly to the motions within the other.

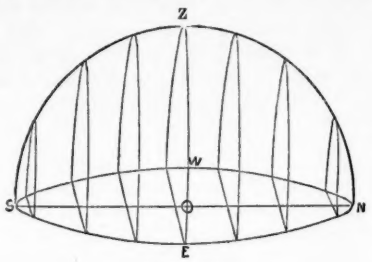


Fig. 1.

In Fig. 1, let O represent the station of the observer, E, S, W, and N, the east, south, west, and north points of his horizon, Z the point overhead, then E Z W represents the course of a star which rises in the east, and the other curves represent the course of stars rising towards the south and north of east. Every star rises straight up from the horizon, and sets equally square to it. Every star, too, is above the horizon, while describing exactly half of its visible course. Further, as the sun is also visible above the horizon while traversing one-half of its diurnal circle—in other words, as night and day are equal — every star which is visible when the sun sets has passed to the west and set there before the sun rises again; and every star invisible when the sun set, makes its appearance above the eastern horizon before the sun rises. In other words, *all the stars upon the sphere of the heavens become visible in the course of a single clear night at any place upon the Equator.** So that the observer can no longer feel any doubt that the earth is limited in all directions beneath the horizon.

Let us consider, then, what our observer has already learned respecting the earth's figure. We shall see that he has obtained enough information to suggest very definite views about the dimensions of the globe on which he has travelled.

His first station was at A (Fig. 2). He travelled northwards to B, and afterwards southwards to C, establishing by the most indisputable evidence the fact that the arc B C is circular, and that the distance of any point upon it from O, the centre of the circle to which the arc belongs, is

---

* After carefully considering the appearances thus presented to the observer situated on the Equator, and recognising the convincing evidence these appearances give respecting the true character of the diurnal rotation, the reader can conceive the indignation with which many gallant naval officers who had often crossed the Equator heard one of the paradoxists lecture at Plymouth to the effect that there is only one pole of the heavens around which all the stars circulate in places parallel to the plane surface of the earth. The lecturer, who was as well aware as they were of the absurdity of his views, succeeded in convincing the simpler among his audience, by asserting that in a particular number of the *Times* which he quoted, it was mentioned in the "Naval and Military Intelligence," that a certain naval officer had seen the pole star from the Tropic of Capricorn (23½ degrees south of the Equator). It was in vain for intelligent persons present to assert that this could not be. The lecturer insisted that it was so, and for some time after he left Plymouth, many were actually persuaded that the earth is plane. At length some one was at the pains to turn over the volumes of the *Times* in the Plymouth Library, and then it turned out (as was to have been expected), that the ship from which the pole star had been seen (the fact was merely mentioned as part of log observations), had been indeed 23½ degrees from the equator, *but to the north instead of the south!*

somewhat less than 4,000 miles. He is now at C, and he learns that in all directions beneath the horizon the earth is limited, because he has proved on indisputable evidence that the stars pass round and beneath the earth, and come up again on the opposite side. He cannot as yet be certain what the shape of the unvisited part of the earth may be, and for aught he knows the section he has found uniformly curved along B C may elsewhere be as irregular as the broken curve shown in the figure. But he is far more likely to believe that in reality this section has a uniform figure either perfectly or very nearly circular.

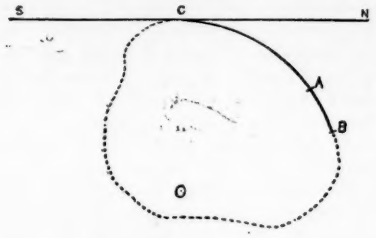


Fig. 2.

Continuing his journey southwards, our observer finds that the north pole of the heavens passes below the horizon, the south pole rising; and now precisely the same rotations which he had observed respecting the North Pole and the motions of the stars around the polar axis, are presented in the southern heavens. As he advances the south pole rises *uniformly*—a relation which, as in the case of the North Pole, shows that he is travelling along a circular arc. He sees the apparent stellar motions continuing as uniformly as before. In fact, the only specific difference in the southern skies consists in the fact that the celestial bodies appear to turn in a contrary direction. This circumstance is noticed in the pages of old Herodotus, who mentions (with some doubt whether it may not be a yarn) that seamen who had passed far southward along the shores of Africa, stated that the sun appeared to move from right to left, instead of from left to right, as with us.

We, of course, who have followed the steps of our observer, as he has progressed southwards, can at once understand why the heavens should seem to move a different way round the pole, and why the sun, as he ascends towards the *north*, appears to travel from right to left, whereas when he ascended from the east towards the *south*, he appeared to travel from left to right. We know that the observer in the southern hemisphere who faces the sun when that luminary is at his highest, and the observer in the northern hemisphere who does likewise are *facing each other*, so that a motion which is from right to left, as seen by one, is from left to right as seen by the other.

(To be continued.)

BRITISH SEASIDE RESORTS,

FROM AN UNCONVENTIONAL POINT OF VIEW.

By Percy Russell.

IV.

THE Isle of Man is, in some respects, the most remarkable of all the islands of England and Wales, and from Snaefell, the highest of its rugged but majestic mountains, there may be had one of the most splendid panoramic views in all the British isles. Thence, indeed, is commanded at once a distinct panoramic view of a very considerable extent of the coasts of England, Wales, Ireland, and Scotland. That noble estuary the Solway, hallowed by so many legendary and historic associations—Ailsa Crag, the famous Mull of Galloway, and the wild mountains of the vicinity are all prominent features, and compose a scene that can hardly be surpassed for beauty and boldness of land and seascape anywhere. The length of the Isle of Man is 33¼ miles, the breadth about 12½, thus bringing every portion within easy pedestrian reach of the sea, and the area is generally computed at 145,325 acres, of which full 50,000 remain virtually in a state of nature. The Calf of Man is a small islet at the south-west extremity, containing only about 800 acres of surface. A chain of veritable mountains extends from north-east to south-west, Snaefell, the highest, being 2,024 ft. above the sea-level. The general scenery is rich in variety, such as most delights the landscape-painter. There are numerous picturesque glens, which seem expressly made for the still life of poetry or romance, and rich undulating tracts of cultivated country, and in fine weather, such a clear atmosphere that the very cornfields when in their full golden glow can be distinctly seen on the adjacent shores. Many beautiful streams rush down from the mountains, and in some of these are excellent salmon-trout, although I am sorry to say that washings from the lead-mines in the interior have in many cases quite destroyed the fish.

Some parts of the interior are boggy, but the glens separating the numerous hills and mountains are frequently wooded with beautiful beech-trees and elder, and the numerous mountain torrents, ending often in beautiful waterfalls, impart a strange charm to the varied landscape. Most of the villages, farm-houses, and churches are embowered in trees, and, for soft rural beauty, the interior of this remarkable island leaves nothing to be desired. The coast is, in many places, of ineffable grandeur, and some of the most formidable precipices are in the immediate neighbourhood of the wild loneliness of harbours, shelving shores, and villages framed in woods, and presenting everywhere quite a material presentment of true pastoral poetry.

Douglas, deriving its name from being at the junction of two streams—the Dhoo (black), and Glass (grey)—lies on the edge of a very picturesque bay. Castle Mona, once the residence of a Duke of Athol, is now a good hotel, and another conspicuous landmark is the Tower of Refuge, built on a rock, for the benefit of shipwrecked seamen. The ancient town is interesting in its narrow streets, but there are comparatively modern marine residences in the recently-built portion, and not only is the living cheap, but the bathing is remarkably good, and the water is singularly free from mud, seaweed, or even shells. The coast north of Douglas is highly precipitous, and what gives beautiful colour in summer to the scenery, is often green with foliage almost to the water's edge. The striking promontory of St. Maughold's Head should be noticed. The well-known town of Peel, formerly called Holm, is remarkable, *inter alia*, for its grotesque and romantic caverns, which resemble nothing so much as sundry of Victor Hugo's poetic flights into the region of the terrible made visible. A small river enters the sea at Peel, and thence once on a time Manx salmon was exported. South of Peel is Brada Head, a truly stupendous pile of black rocks, somewhat like those which give to Spanish Head, close to the Calf of Man, such an imposing appearance. The lead-mines often run here close to the sea, as in Cornwall. The Spanish Headland is very grand, and the masses of rocks off the coast look like piles of huge timbers or regular blocks of masonry all laid ready for rearing some colossal structure, while the prevailing blackness of the cliffs im-

XUM

parts a grim and stern character to what is certainly remarkable scenery.

But to return. One of the great attractions of Peel is, of course, its terrible castle, once the frequent residence and long the formidable fortress of those Lords of Man, the Earls of Derby. The prison vaults under the castle still exist, fearful mementos of what feudal imprisonment meant; and here Elinor Cobham, Duchess of Gloucester, was imprisoned for life. This place is also connected with the old Manx legend of a spectre dog, which it was a very serious matter indeed for any one to encounter. The fine ruins of the Cathedral of St. Germains, built 1245 A.D., should be examined, and the insulated rock on which these remain—Sodor—possesses permanent interest, being, like the historic Iona, the place whence the original savages of the islands first derived some of the lights—very broken they were, in truth—of mediæval knowledge. Sodor, as everybody knows, has puzzled etymologists considerably; some authorities declaring that it is simply derived from Sudureys, which would mean merely the Southern Hebrides, with which the Isle of Man was once associated.

Very great improvements have been effected of late years at the principal ports of the island, and particularly is this the case at Douglas.

I obtained recently some special information on this head from Sir Henry B. Loch, whose beneficent rule will long be remembered by the Manxmen, and who is now the Governor of Victoria, Australia. Sir Henry did much to advance the material progress of the island, and in improving the social and moral state of the people he was ably seconded by Lady Loch. In the space of five years only the tonnage entering Douglas was raised from a value of £100,000 to £500,000, and the splendid sea defence and docks constructed in the harbour are reckoned as among the largest examples of solid concrete at the greatest depth of water in the United Kingdom.

(To be continued.)

NOTES ON COAL.

By Richard A. Proctor.

IT has become a question of serious import whether we may indeed look confidently for abundant supplies of coal during many future years, or whether those have been in the right who have told us that before the close of the present century this country must feel the effects of the over-rapid working of our chief coal-fields.

I propose briefly to sketch what is known about the origin of coal, and then to touch on the subject of the supply of this mineral, with special reference to the requirements of our own country.

A mistaken impression is somewhat widely prevalent that, in the coal-fields, we have the remains of ancient forests; in other words, it is supposed that, wherever there was a forest in primæval times, there now exists a coal-field of greater or less extent. In connection with this view, also, the opinion is entertained that the forests now in existence will, in process of time, and after due geological changes, become the coal-beds of future ages.

But although, as we shall presently see, the coal-fields are undoubtedly due to the vegetation of former eras, it is far from being the case that the primæval forests became converted in a general way into coal. Conditions of a peculiar, and to some extent exceptional, character were requisite for the formation of coal-fields. If we consider the evidence given by the coal-fields themselves, we shall see what these conditions were.

The beds or seams of coal form but a small portion of the thickness of the great geological group of strata to which they for the most part appertain. This group is called the *carboniferous*, and not uncommonly "The Coal"; but even where coal is most abundant, it forms only a minute part of the whole mass. Thus it has been estimated, Sir Charles Lyell tells us, that in South Wales the thickness of the carboniferous strata amounts in all to between 11,000 and 12,000 feet (or more than two miles);* "but the various coal-seams do not," according to Professor Phillips, "exceed in the aggregate 120 feet," or little more than one-hundreth part of the whole. In North Lancashire the carboniferous strata occupy a depth of more than three and a half miles, with the same relative disproportion between the thickness of the coal-seams and that of the complete series of strata. Again, in Nova Scotia the coal-bearing strata attain a thickness of more than three miles.† Here no fewer than eighty seams of coal have been counted (seventy-one having been exposed by the action of the sea); but these seams are nowhere more than five feet in thickness, and many are but a few inches thick. Thus it is evident that the formation of coal can have been in progress but for a short portion of the time during which the great carboniferous series of strata was in process of deposition. Throughout by far the greater portion of that time other minerals were being deposited.

It is next to be noticed that under each coal-seam a stratum of older soil exists, in which there are commonly found the roots of ancient trees; while above the coal there is commonly a layer of shale or sandstone, in which not unfrequently the trunks of those trees are found either fallen or still in their original position, and only partly converted into coal. The bark remains, but is transmuted into coal; the hollow of the trunk, decaying long before the trunk gave way, is represented by a *cast* in sandstone. Thus, if we try to picture to ourselves the state of things which existed when such a seam of coal first began to be covered up by the next higher deposit, we see that there must have been trees standing erect above a layer of vegetable matter, the roots of the trees being imbedded in the soil which forms the deposit next below the coal. The vegetable layers may probably have been two or three times as thick as the resulting coal-seam, and were reduced by pressure to their present thickness; but such layers cannot at any time have reached to the branches of the forest-trees. Then the process of deposition began. This can only have happened when some subsidence of the soil had caused it to be submerged to a greater or less depth. We can infer from the depth of the strata overlying the coal-seams that this state of submergence continued in many cases for a long period of time; and it is equally clear that the formation of the vegetable layers themselves must have been a process occupying a considerable time, since tall trees grew before the next submergence took place. So soon as submergence was complete, the tall trees perished and began to decay. The stout trunks above the vegetable layer were broken off and swept away by the

* It is, perhaps, hardly necessary to remark that this depth has not been measured anywhere in a vertical direction. The thickness of the several layers can be measured where they either crop out, or show at the surface, or else come within the range of mining operations; and thus the total depth of the series can be estimated.

† The way in which this has been made known is worthy of notice. In the Bay of Fundy the tides run to an enormous height. The tidal wave can be seen when it is still thirty miles away, advancing with a prodigious uproar, and rising sometimes to the height of more than a hundred feet. These tremendous waves have not only produced a continuous section ten miles long, through the inclined strata, but by their action they sweep away continually the whole face of the cliffs, and bring into view fresh sections year after year.

sea. The forest itself, properly so called, was for the most part thus destroyed. It was the decaying refuse of the forest, intermixed with the lowlier growths, which formed the coal-seam as it now exists. Amongst these were the lower parts of the trunks of the ancient forest-trees. These became converted, like the rest of the vegetable matter, into coal.

But it may be asked how those portions of the trunks which still remain above the level of the vegetable layer are to be accounted for. Are we to suppose that they remained erect after the sea had made its way into the domain of the ancient forest? Many geologists think so; and doubtless the stumps of stout trees might resist for a long time the action of the sea waves. But there seems good reason for believing that, when the submergence first took place, these stumps stood but little above the upper surface of the vegetable layer, or that in many instances the trees were broken off even below that level. Then, as the pressure of the superincumbent layer gradually increased with the layer's increase of thickness, the vegetable matter was pressed down below its former level, and the stumps were left standing above the depressed surface of the vegetable layer. This explains the conversion of the bark of these stumps into coal, since there is every reason to believe that stumps simply left imbedded in sandstone would not change into pure coal.

In passing, I may remark that in whatever way it happened that the stumps of the ancient forest-trees remained standing above the level of the vegetable mass forming the coal-seam, a strange result has followed. The upper part of the stem became filled, as I have said, with sandstone, forming a cast of the interior of the ancient tree; the bark became coal; and outside the bark is sandstone again. Thus there is a mass of sandstone separated from the surrounding sandstone by a tube of coal. This mass is not cylindrical, being larger below than above; so that if in any way the mass ceases to be supported, it falls like a bolt from a gun. But in working the coal-seam the material which had supported the sandstone mass is necessarily removed. Hence the miners look with dread on these coal-pipes, as they are called, which each year cause fatal accidents in the Newcastle and other coal-fields. As Sir Charles Lyell well remarks: "It is strange to reflect how many thousands of these trees fell originally in their native forests in obedience to the law of gravity, and how the few which continued to stand erect, obeying, after myriads of ages, the same force, are cast down to immolate their human victims."

(To be continued.)

NOVEL TRICYCLES.

By John Browning.

(Chairman of the London Tricycle Club.)

THE EMPEROR.

HAVING obtained one of these very novel machines, I took it to Reigate to give it a thorough trial. On mounting the machine, for the first few minutes' riding my course was somewhat erratic, showing that it requires a little practice in steering. The difficulty was soon surmounted, and I may say at once that the machine is certainly easier to steer that the Humber, and that with experience it is completely under control.

The method of applying the brake by means of the left foot is very peculiar, and at first a rider feels awkward in using it, but this feeling soon wears off. When running down a long hill with varying grades it seems difficult to vary the pressure of the brake with the foot; yet there is a simple method, as I discovered in my second ride, by which this may be done with the greatest delicacy.

Whenever the brake has to be applied continuously for some time, the left foot should be put on the brake-pedal just above the axle, and the right foot on the opposite, or right-hand side of the axle, then a slight lifting action of the *right* foot—that is, a slight decrease in the pressure of the right foot—will cause an increase of pressure on the left foot, and thus the brake can be applied as gently as any hand-lever brake, and the pressure regulated with as much nicety. I agree with Mr. Bennett, who tells me that he has ridden 1,500 miles on the Emperor, that it is desirable that the power of the brake should be increased for the steepest, that is, downright dangerous hills.

The Emperor is a good hill-climber. I have ridden the Woodhatch-hill, out of Reigate on to Earlswood-common, on a machine geared to 52 in., and that without practice and without strain. Some skill is undoubtedly required to ride the Emperor, but what it requires, more than skill, is confidence. It looks and feels a risky thing to do, to put your feet up on the axle when flying a hill, but it is tolerably easy and safe to do it, unless the hill is almost unrideably steep.

The machine is made with 42-in. side-wheels, geared to 52 in. The hind wheel, which is about 30 in. diameter, is the driving-wheel, and is driven by means of a chain. The machine is a front-steerer, both the front wheels moving with the axle for steering. It is, of course, a single driver, but I have not as yet found the driving-wheel slip, either on mud or dust, even when climbing hills. Some contrivance is required for tightening the chain when it becomes slack.

The Emperor can be mounted or dismounted either from the front or behind. I prefer to mount it behind from the pedal, and dismount from the front over the axle.

There is no fear of falling head first out of this machine when descending a hill, as, if the feet are in their proper place on the brake and axle, the rider has an open front before him, and can always come down on his feet.

If the Emperor were made about 5 lb. or 10 lb. lighter—and this might easily be done—and a little more brake power were given, the machine would, I think, take a good position, and soon be a favourite.

But as back-pedalling can only be performed with one foot, the brake on this machine is all important, and unless the brake-power on the hind driving-wheel can be increased—which I venture to doubt—it will be necessary to apply band-brakes to both the front wheels, which might be done readily by means of a hand-lever; and to this most riders would give the preference.

The Emperor may be obtained of Mr. Brooke Hitching, the tricycle agent of Ludgate-hill, E.C.

THE COVENTRY CHAIR.

A year or more ago I suggested in Knowledge that Sociable tricycles might be employed at country railway-stations to carry passengers and luggage.

Messrs. Starley & Sutton, the manufacturers of the Meteor and the Rover, have brought out a modified tricycle which they call the Coventry Chair. This is intended to supersede the present Bath Chair, which is now generally dragged along at a crawling pace of about two miles an hour at the utmost. The Coventry Chair can be driven easily at a pace of five or six miles an hour. The wheels have india-rubber tyres, and the chair is mounted on tricycle springs; the motion is therefore easy and pleasant. The engraving shows that the invalid sits on a light wicker

chair, in front of and below the driver, who pedals behind him.

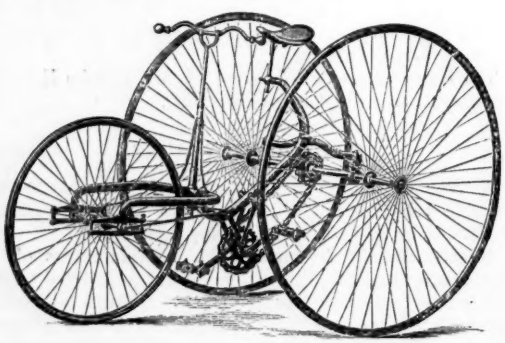
In a trial which recently took place of the Coventry Chair, an untrained workman, with a sitter weighing between eleven and twelve stone in the chair, drove from Coventry to Birmingham, and back—a distance of thirty-five miles—in four and three-quarter hours, including stoppages amounting to thirty-five minutes; the riding time was thus only four hours and ten minutes—a pace of between eight and nine miles per hour.

I expect very soon to see some Coventry Chairs in our sea-side watering-places, and wish the ingenious and spirited inventors success.

I cannot resist the opportunity of pointing out how this machine proves the accuracy of one of my so-called theories that a large amount of weight may be thrown upon the front steering-wheel of a tricycle with advantage.

THE NEW QUADRANT.

Messrs. Lloyd Bros. have kindly shown me a new front-steering Quadrant tricycle, of which I think highly. The machine is very light, weighing only 50 lb. with a brake. It has 40-in. driving-wheels, and a 26-in. front-steering-wheel. Of course, this large steering-wheel has only been rendered possible by the use of the ingenious Quadrant system of steering. The makers have had the courage to throw the weight of the rider on to the steering-wheel and in front of the driving-wheels, and so to dispense with the weight and inconvenience of back-stays to prevent the machine from capsizing backwards. I say they have adopted the correct plan in making a machine which cannot in this particularly dangerous manner be capsized, because I have known of two bad accidents occurring to my own friends, owing to these back-stays, which were to prevent accidents, themselves giving way.



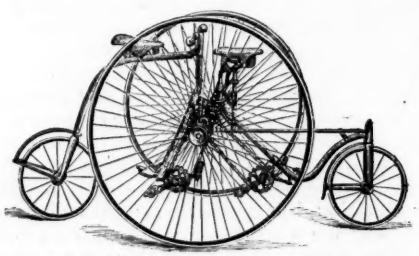
The driving-wheels of this Quadrant are only 40-in. diameter, and it is spoken of by those who have tried it as an exceedingly fast machine. I confess I feel greatly interested in its success, as it embodies every important point in its construction which I have for some time been urging on manufacturers, viz., small driving-wheels, large front-steering-wheel, and the weight of the rider thrown well upon it. Its success would prove, in a machine which can be purchased in the open market, that the advantages of small wheels are not, as has been so frequently asserted, confined to the Humber type of tricycle.

I should exceedingly like to test this new Quadrant well, but the only machine I could get at present is one without a brake, geared to 60-in. Now a 50-in is the very highest gearing I can ride with advantage in a one-speed machine, and I should, therefore, be only trying myself, and not the machine, if I were to take it, as I should do, over a hilly line of country, as I consider this the true method of testing a tricycle.

I anticipate that this will prove the fastest of the front-steering machines, as well as one of the safest.

THE CLUB TANDEM.

The Coventry Machinists' Company have introduced yet another new Tandem. This machine is a good front-steering tricycle, with a movable backbone attached by a joint behind in the centre of the axle. This carries a small wheel and a saddle for a second sitter. The front rider steers, but the machine can be arranged so that either rider can steer, and either rider can now apply the brake.



The riders do not sit so close together as on many Tandems.

By removing three small bolts the Club Tandem can be converted into an excellent front-steering machine for a single rider.

I have had no experience in riding this machine, though I have been on one, but I do not see how it can fail to perform well.

THE INTERNATIONAL HEALTH EXHIBITION.

XV.—WATER AND WATER-SUPPLIES—(*continued*).

Type VI.—"Chamberland's" Filter.—Amongst the interesting group of exhibits in the French Court, under the direction of the distinguished professor of the École Normale, of Paris, there are a few examples of this type of filter open to inspection. It has been specially designed for laboratory work, and consists of a hollow cylinder closed at one end, made out of biscuit china; probably a hydrous silicate of alumina and lime passed through a preliminary or biscuit furnace. The water is forced to percolate through the walls of this comparatively dense material, and, in doing so, becomes divested of even the minutest germs, such as *Bacilli*, &c.; and, so thoroughly does it accomplish its work, that M. Pasteur has relied upon it for water in his experiments upon the culture of the lower forms of life.

Type VII.—Maignen's "Patent Filtre Rapide." We

have reserved this type of filter for our final example, inasmuch as it will help us to explain in detail what a thoroughly good household filter ought to be. Water suitable for drinking and cooking should be free from taste and smell, yet so aërated and cool as to become refreshing. It is needless to say that it ought also to be not only free from harmful matters, but more, its administration should be beneficial. The commonest impurities that are met with in waters are adventitious particles derived from the earth or its atmosphere; they are more or less of appreciable dimensions, and include such matters as the silt and other detritus of streams, and organic matter, both living and dead. There are also other impurities of a less evident nature, derived from both living and inert matter dissolved in the water; so that the requirements of a perfect filter are twofold: it should be an efficient mechanical strainer as well as a chemical separator. Nor is this all; it must conform to the peculiar senses of man; to his organs of taste, his eye, and—if the truth must be written—to his pocket.

We insist at the beginning that the domestic filter shall be "a thing of beauty," even though it be made of such a homely substance as brown stoneware. Placed upon the sideboard, chiffonier, or other stand, the tap should be at a convenient distance from the surface of the table, so as to permit of the easy insertion of a tumbler beneath it, as shown at Fig. 29. Such pedestals, we are glad to find,

Fig. 29.—Maignen's Refrigerating Stand, with "Filtre Rapide" and Ball-valve attached.

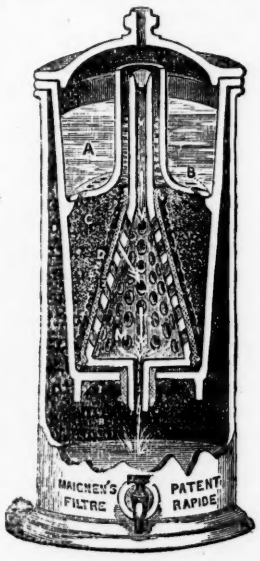


Fig. 30.—Sectional view of the "Filtre Rapide." A, unfiltered water; B, screen; C, granular "*carbo calcis*"; D, powdered "*carbo calcis*"; E, asbestos cloth; M, filtering frame; R, reservoir.

are supplied by Mr. Maignen; and we notice with pleasure that he has turned the pedestal to account to serve as a "refrigerating stand," Fig. 29, where the filtered water is made to pass through a non-oxidisable tin pipe imbedded in ice—a most delightful luxury for the summer months.

The filter-case ought to be constructed in such a way as to permit of being taken to pieces, and the shapes of the component parts such as to allow of their being easily and thoroughly cleansed. It is but our duty to state that Mr. P. A. Maignen must always be associated with this most important advance in the structure of filter-cases as its originator, and we may point to Fig. 30 as substantially a perfected model. We need not here enter into a detailed explanation of Mr. Maignen's filter-case, as we have already done so in a former issue. Those of our readers, however, who cannot have access to our previous brochures, and who are desirous of learning something more about Mr. Maignen's filter-case than the pictured description, Fig. 30, would do well to write to him for a copy of his excellent pamphlet on the filtration of water.* We may observe, however, that the filtering mechanism consists of a funnel, M, Fig. 30, the expanded portion of which is pierced by many circular apertures; that *over* this an asbestos cloth is fitted; and that the filtering medium is deposited uniformly over the *whole* of this surface. The idea of the asbestos cloth and perforated funnel has, we find, been taken advantage of by another manufacturer, but, most unfortunately for him, he has reversed the funnel and made a kind of a bag of it; over the hollow cone the asbestos cloth is tied, and the perforations in the funnel are elongated slits; hence it is obvious that the filtering surface is only partially available, and the filtered water is not properly aërated, as in the filter-case Fig. 30, where the stem of the funnel, suitably plugged with cotton wool, to prevent the entry of disease-germs, allows a stream of purified air to enter the reservoir of filtered water underneath.

The asbestos-cloth surface is undeniably Mr. Maignen's invention; it is of such a nature, that a very fine powder, such as the "*carbo calcis*," enters into association with it in such a way as to form one of the most perfect strainers known. The cloth is subjected for a prolonged time to an intense heat, so as to thoroughly purify it ere it is sent out with the filter, and in order to cleanse it after continued use, Mr. Maignen directs that it ought to be washed, and then roasted before a clear fire; this can be done in any kitchen.

The filtering medium is termed *carbo calcis*, because it is made of pure carbon and pure lime, combined by the patented process. It is in such a fine state of division that it has been estimated that one square inch, $\frac{1}{8}$ inch thick, contains over 200,000 square inches of adhesive or straining surface. Thus, when spread over the asbestos cloth, it ought to be capable of preventing the passage over of even the smallest germs — *e.g.*, excessively small *Micrococci* measure only about $\frac{1}{25000}$ inch in diameter, and other *Bacteria* and *Bacilli* are proportionately larger; even the *flagella* of *Bacterium termo*, *i.e.*, the whip-like terminal appendicular organs of motion of the organism, measure $\frac{1}{204700}$ inch in breadth.†

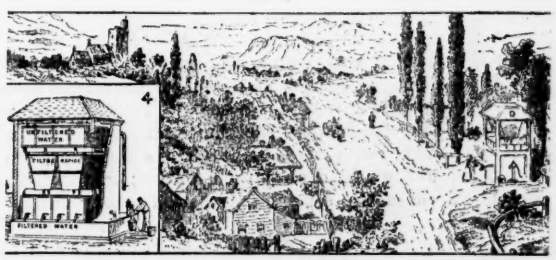


Fig. 31.—A Village Filter House.

Over the fine layer of powdered *carbo calcis*, D., Fig. 30, a quantity of granular *carbo calcis* may be placed, as at C, Fig. 30; this does not only arrest the coarser impurities in

* "Water, Preventable Disease, and Filtration." By P. A. Maignen, 22 and 23, Great Tower-street, London, E.C., 1884.

† Dallinger, "Monthly Microscopical Journal," London, vol. xiv. p. 105.

XUM

the water, but prolongs the efficacy and speed of the filtration. As a chemical reactor, *carbo calcis* is equal, if not superior, to any other medium of its kind. It removes iron, lead, sewage poisons, and even ammonia and sulphuretted hydrogen. It also reduces the hardness of water to an appreciable extent. As soon as it becomes foul, it may be replaced by a fresh charge at a trifling cost, and thus entirely overcomes the objection to the use of organic carbon as a filtering agent.

The requirements of a good drinking water are that it shall be tasteless, odourless, colourless, cool, and refreshing; that, in order to be so, it shall be aërated with purified air or carbonic acid gas; and that it shall neither be too hard nor too soft, and be free from all septic or other deleterious impurities. The filter that can modify foul water which is alike disagreeable to the eye, nose, and mouth, and which, when it enters the alimentary system, becomes dangerous, and endow it with all the qualities of good, wholesome water, and which, moreover, is within the reach of the humblest cottager, needs no word of commendation —it speaks for itself. Such a filter is Maignen's.

It is not, then, a matter for astonishment that the Executive Council have deemed the "Filtre Rapide" worthy of the place they have assigned to it, and visitors to the Exhibition may now drink freely from the fountains without any fear of being injured thereby. Mr. Maignen has informed us that he has recently furnished the "Nile Expedition Commission" with 800 filters. Each instrument is capable of purifying from ten to twenty gallons per hour, measures 18 by 12 by 10 inches, and weighs only 16 lb. Two buckets are telescoped round the filter, one furnished with a long strap to draw the water from the river, and the other placed under the filter to receive the purified water. We believe that Sir Peter Lumsden has also taken a few of these valuable travelling companions with him to Afghanistan. Doubtless the merits of the Filtre Rapide will soon make it a universal favourite, when the village smithy may be flanked on one side by its rural "Filter House" (Fig. 31), and water companies seek its aid to give us better water.

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

By Mons. de Fontenelle.

WITH NOTES BY RICHARD A. PROCTOR.

THE SECOND EVENING (*continued*).

"BUT what do you think," said she, "of the people in the moon; are they as fearful of an eclipse as we are? It would be a good jest to see the Indians there up to the neck in water; that the Americans should believe the earth angry with them; the Greeks fancy we were bewitched, and would destroy their plants; in short, that we should cause the same consternation among them, as they do here."

"And why not?" said I. "I do not doubt it at all; for why should the people of the moon have more wit than we? What right have they to affright us, and not we them? For my part, I believe that since a prodigious company of men have been, and still are such fools to adore the moon, there certainly are people in the moon that worship the earth, and that we are upon our knees the one to the other."

"But sure," said she, "we don't pretend to send any influences to the moon, and to give a crisis to her sick; if the people have any wit in those parts, they will soon destroy the honour we flatter ourselves with, and I fear we shall have the disadvantage."

"Fear it not, madam," said I; "do you think we are the only fools of the universe? Is it not common for ignorance to spread itself everywhere? 'Tis true, we can only guess at the folly of the people in the moon, but I no more doubt it, than I do the most authentick news that comes from thence."

"What news comes from thence?" said she.

"That which the learned bring us," I replied, "who travel thither every day with their tubes and telescopes; they will tell you of their discoveries there, of lands, seas, lakes, high mountains, and deep abysses."

"I fancy, indeed," said she, "they may discover mountains and abysses, because of the remarkable inequality; but how do they distinguish lands and seas?"

"Very easily," said I; "for the waters letting part of the light pass thro' them, send back but a very little, so that they appear afar off like so many dark spots*; whereas the lands being solid, reflect the whole light, and appear to be more bright and shining. The illustrious Monsieur Cassini, a most compleat astronomer, has discovered something in the moon which divided, then reunited, and sunk in a kind of well: we may very probably suppose this was a river. Nay, they pretend to be so well acquainted with the several places, that they have given them all names: one they call Copernicus, another Archimedes, another Galilæus: there is the Caspian Sea, the Black Lake, the Porphyrite Mountains; in short, they have publish'd such exact descriptions of the moon, that a very almanack-maker will be no more to seek there than I am in Paris."

"I must own, then," said the Marchioness, "they are very exact; but what do they say to the inside of the country? I would very fain know that."

"'Tis impossible," I replied; "the most learned astronomers of our age cannot inform you. You must ask that of Astolfo, who was carried into the moon by St. John. I am going to tell you one of the agreeable follies of Ariosto, and I am confident you will be well pleased to hear it. I must confess he had better have let alone St. John, whose name is so worthy of respect; but 'tis a poetical licence, and must be allowed. The poem is called 'Orlando Furioso,' is dedicated to a Cardinal, and a great Pope has honoured it with his approbation, which is prefixed to several of the editions. This is the argument: Orlando, nephew to Charlemain, runs mad because the fair Angelica prefers Medore before him. Astolfo, a knight-errant, finding himself one day in the terrestrial Paradise, which was upon the top of a very high mountain, where he was carried by his flying horse, meets St. John, who tells him, if he would have Orlando cured, he must make a voyage with him into the moon. Astolfo, who had a great mind to see new countries, did not stand much for entreaty; and immediately there came a fiery chariot, which carried the apostle and the knight up into the air. Astolfo, being no great philosopher, was surprised to find the moon so much bigger than it appeared to him when he was upon the earth; to see rivers, seas, mountains, cities, forests, nay, what would have surprised me too, nymphs hunting in those forests; but that which was most remarkable was a valley where you might find anything that was lost in our world, of what nature soever—crowns, riches, fame, and an infinity of hopes; the time we spend in play and in searching for the philosopher's stone; the alms we give

* It is interesting to find Kepler's notion that the dark parts of the moon are seas prevailing after Cassini's time.—R. P.

after our death, the verses we present to great men and princes, and the sighs of lovers."

"I know not," said the Marchioness, "what became of the sighs of lovers in Ariosto's time, but I fancy there are very few of them ascend to the moon in our days."

"Ah, madam," replied I, "how many does your Ladyship send thither every day? Those that are addressed to you, will make a considerable heap; and I assure you the moon keeps all safe that is lost here below. Yet I must tell you, Ariosto does but whisper it, though every thing is there, even the donation of Constantine, (the Popes have pretended to be masters of Rome and Italy by virtue of a Donation which the Emperor Constantine made Sylvester; and the truth is, nobody knows what is become of it.) But what do you think is not to be found in the moon? Folly; all that ever was upon the earth is kept there still; but in lieu of it, it is not to be imagin'd how many wits (if I may so call them) that are lost here, are got up into the moon; they are so many vials full of a very subtile liquor, which evaporates immediately, if it be not well stopp'd; and upon every one of these vials the names are written to whom the wits belong; I think Ariosto has heap'd 'em upon one another a little confusedly; but, for order sake, we will fancy 'em plac'd upon shelves in a long gallery. Astolfo wondered to see several vials full, inscribed with the names of persons whom he thought considerable for their wisdom. To confess the truth, I begin to fear, since I have entertained you with these philosophical and poetical visions, mine is not very empty: however, 'tis some consolation to me, that while you are so attentive, you have a little glass full, as well as your humble servant. The good knight found his own wits among the rest, and, with the apostle's leave, snuffed it all up his nose, like so much hungary-water; but Ariosto said he did not carry it far; it returned again to the moon a little after.

*——The love of one fair Northern lass,
Sent back his wit unto the place it was.

"Well, he did not forget Orlando's vial, which was the occasion of his voyage; but he was cursedly plagued to carry it, for heroes' wits are naturally very heavy, and there did not want one drop of it. To conclude, Ariosto, according to his laudable custom, addresses himself to his mistress in the following beautiful verses:—

Fair mistress, who for me to Heaven shall fly,
To bring again from thence my wandering wit?
Which I still lose, since from that piercing eye,
The dart came forth that first my heart did hit:
Nor of my loss at all complain would I,
Might I but keep that which remaineth yet;
But if it still decrease, within short space,
I doubt I shall be in Orlando's case.

Yet, well I wot where to recover mine,
Tho' not in Paradise, nor Cynthia's sphere,
Yet doubtless in a place no less divine,
In that sweet face of yours, in that fair hair,
That ruby lip, in those two star-like eyes,
There is my wit, I know it wanders there;
And with my lips, if you would give me leave,
I there would search, I thence would it receive.

"Is not this very merry? To reason like Ariosto, the safest way of losing our wits is to be in love; for you see they do not go far from us, we may recover 'em again at our lips; but when we lose 'em by other means—as, for example, by philosophising—whip, they are gone into the moon, and there is no coming at 'em again when we would."

"However," said the Marchioness, "our vials have an honourable station among the philosophers, when 'tis forty to one but love fixeth our wits on an object we cannot but be ashamed of. But to take away mine entirely, pray tell me, but tell me seriously, if you believe there are any men in the moon; for methinks hitherto you have not been very positive."

(*To be continued*).

* Sir J. Harrington's translation of "Orlando Furioso," lib. 36.

Editorial Gossip.

A curious illustration of the impossibility of abolishing social distinctions reaches me from the other side of the Atlantic. In an article on "Second-class Cars," in the *Railway Review* (a journal published in Chicago), I read:—

No matter how much we may ignore, theoretically or politically, the existence of class distinctions as something foreign to our system of government, they do exist, nevertheless, as rigorously and as unavoidably here as anywhere else, and in the relations of business they have got to be dealt with as such.

Just so; for, as Horace wrote some 1,900 years ago, "Naturam expellas furcâ, tamen usque recurret." You may decree that one man shall be as good as another (and, according, the Irishman's addendum is the venerable Joe Miller, "A grate dale betther too!"), yet people will no more meet universally on an equality than oil and water will unite in a bottle. You will never get the possessor of birth, cultivation, and refinement to consort freely with the vulgar and illiterate man, if you shout "Liberty, equality, and fraternity" until you are black in the face; and the suggestion (from a purely business point of view) to establish second-class carriages in the greatest Republic in the world affords pretty convincing proof that it is as impossible, by legislation, to equalise men's social relations as it is the length and shapes of their noses.

I was, I confess, much interested to read extracts from Knowledge in the *Hindu Excelsior Magazine*, a monthly Madras journal, conducted—and very ably conducted, too—by a native gentleman, Mr. R. Sivasankara Pandiah, B.A. It is pleasant to find that words penned primarily for Englishmen are read with appreciation by those who, though of different race and creed, and separated from us by so many thousands of miles of land and water, are yet our friends and fellow-subjects.

Every one who has an interest (and who has not?) in the condition of our Lunacy Laws, should read the remarkable series of papers, "My Experiences in a Madhouse," which began in the *Pall Mall Gazette* for Aug. 27.

From some further particulars of the balloon of MM. Renard and Krebs which have been received, it would appear that its lifting power in excess of the entire weight was but small, and that the weather was "presque calme." It remains to be seen what progress can be made against a gale of wind—or even a stiff breeze. I fear that the problem of aërial navigation is not yet solved.

I have received the Presidential address (on Psychology) of the Hampstead Naturalists' Club, and am glad to find that excellent Local Association in so flourishing a condition.

The *Citizen* states that since the removal of the Natural History Collections from the British Museum to South Kensington the number of daily visitors has diminished from 2,500 to about 1,000.

XUM

AN APOLOGY TO DR. KINNS.

I INTIMATED, on p. 204, my earnest anxiety that justice should be done to Dr. Kinns. I now hasten to render it. Having carefully read through the edition of his book just published, from beginning to end, I feel that, differing, as I do, from him in the inferences he draws from his facts, I can the more willingly, and with the less bias, bear testimony to the entire accuracy of the very large number of scientific facts which he has brought together. A paragraph on abnormal refraction which appeared in the only edition of "Moses and Geology" that I had previously seen (and upon which I placed an interpretation repudiated by Dr. K.) has been expunged from the present one; and I can only frankly express my regret that I should have brought a charge of ignorance, which a simple perusal of the volume before me suffices amply to refute. I do not know whether it is necessary to reiterate here that I never did—as assuredly I never intended to—make the very slightest insinuation against Dr. Kinns's personal character, honour, or veracity. They have been as unassailed in these columns as they are unassailable.

Reviews.

SOME BOOKS ON OUR TABLE.

Suggestions for Establishing Popular and Educational Museums. By Thos. Laurie. (London: Laurie.)—In this pamphlet Mr. Laurie offers suggestions for the establishment of local museums of science and art, which may be studied, not without profit, by those interested in popular education. His ideas as to the collection of objects illustrating the local industry of the place in which the museum is situated seem good, and he further gives a list of anatomical and physiological models, works of art, wall charts, &c., which he considers should form part of every collection established for educational purposes.

Hospital Sunday and Hospital Saturday. By Henry C. Burdett. (London: Kegan Paul, Trench, & Co.) 1884.—Mr. Burdett finds grave fault with the administration of the funds collected on what are known as Hospital Sunday and Hospital Saturday—especially with the latter. All who are anxious that the very large sums of money gathered on these days should be applied to the greatest advantage to the alleviation of sickness and suffering, should study the pamphlet whose title heads this notice.

Children's Dress. A Lecture delivered in the Lecture-room of the International Health Exhibition by Miss Ada S. Ballin. (London: W. Clowes & Son.)—This eminently practical lecture may be commended to the serious consideration of the parents of all young children. That our present unscientific mode of clothing them gives rise to imperfect development, disease, and even death, can unhappily hardly be denied; and those who wish to see their youngsters happy and healthy can scarcely expend sixpence more profitably than in the purchase of the instructive pamphlet before us.

Text-book of Practical Solid or Descriptive Geometry. By David Allan Low. Part II. (London: Longmans, Green, & Co., 1884.) This is the second volume of the work, concerning the previous part of which we were able to speak so favourably on p. 97. The commendation which we bestowed upon that we are equally able to extend to the conclusion of Mr. Low's really excellent book. We have, however, one fault to find with it, and that is that its author persists in that most unscientific solecism, the use of " for inches. " means seconds of arc and nothing else, and it is as legitimate—or as illegitimate—to employ it to indicate a measure of length, as it would be to use £ as the symbol for a gallon.

We have also on our table *Cassell's Popular Gardening*, *The Book of Health*, *The Library of English Literature*, *European Butterflies and Moths*, *Cassell's Household Guide*, *The Countries of the World*, and *The Franco-German War*, *Longfellow's Poems* (illustrated), all published by Cassell & Co.; *Pitman's Musical Monthly*, a surprisingly cheap and useful publication for musical amateurs of limited means; *Water Supply to Villages and Rural Districts*, by E. Bailey-Denton, C.E., B.A.; *The Journal of Botany*, *Bradstreets*, *The Railway Review*, *The Tricyclist*, *Society*, *The Index*, *Our Monthly*, the *Hindu Excelsior Magazine*, and the *Syllabus of the Day and Evening Classes of the Mason Science College for* 1884–5.

THE FACE OF THE SKY.

From September 12th to September 26th.

By F.R.A.S.

SPOTS and faculæ continue to appear in sufficient number on the Sun's disc to render the daily scrutiny of his surface almost certainly productive of interesting results. The configuration of the night sky may be gathered from Map IX. of "The Stars in their Seasons." A minimum of Algol ("The Stars in their Seasons," Map I.) will happen at 2h. 43m. a.m. on Sept. 25th. At 3 p.m. on the 19th, Mercury comes into inferior conjunction with the Sun, and is of course but poorly placed indeed for the observer about this time. He may, however, probably be caught as a morning star about the time when these notes terminate. Venus is still a most striking and brilliant object in the morning sky, rising as she does between 1 and 2 a.m. during the next fortnight. In the telescope she presents the phase of the Moon in her last quarter. She attains her greatest elongation (46° 5′) west at noon on the 21st. Neither Mars nor Jupiter is yet in a position for observation. Saturn, however, rises before 10 p.m. on the 12th; and just after 9 o'clock at night by the 26th. He is still to the north of ζ Tauri ("The Stars in their Seasons," Map I.) Uranus is for the present removed from the ken of the observer, as is Neptune too. The Moon is new on the 19th, and she does not enter her first quarter until 21 minutes past 10 o'clock in the morning of the 27th. She will only be fully observable during the last three days of the interval which our notes cover. During that period she will occult two stars at moderately convenient hours. We gave the particulars of the first occultation a fortnight ago on p. 182, but repeat them here. On the night, then, of September 12th, the Moon, before rising, will have occulted the 6½th mag. star BAC., 1930. Later, after she has risen, the star will reappear from behind her dark limb at 11h. 14m., at an angle from her vertex of 220°. The second occultation will occur on Sept. 25, when the 6th mag. star 29 Ophiuchi will disappear at the dark limb of the Moon at 5h. 28m. p.m., at a vertical angle of 126°; reappearing at her bright limb, at an angle of 258° from her vertex at 6h. 41m. p.m. When these notes begin the Moon is in Taurus, but at 7 o'clock this evening she will pass into the extreme north part of Orion. Twelve hours later, *i.e.*, at 7 o'clock to-morrow morning, she will have crossed this strip of sky and entered Gemini. It will be 10 p.m. on the 14th before she quits Gemini for Cancer, and in Cancer she remains until noon on the 16th, when she crosses its boundary into Leo. Travelling through the last-named constellation, she descends into Sextans at 3 p.m. on the 17th, re-emerging in Leo at 3 o'clock the next morning. She finally quits Leo for Virgo at 4 a.m. on the 19th. Her passage through Virgo occupies until noon on the 22nd, at which hour she crosses the boundary into Libra. At 1 p.m. on the 24th, she enters the narrow northern strip of Scorpio, which she has traversed by midnight. She then passes into the southern part of Ophiuchus, where she continues until 10 p.m. on the 26th. At this hour she crosses into Sagittarius, where we leave her.

The oldest college in the United States (with the exception of Harvard), viz., William and Mary College, Virginia, has been compelled to close its doors, having but one student at the beginning of the present school year. It was founded in 1693, and has had amongst its eminent *alumni* Washington, Randolph, Tyler, Breckenridge, and General Scott.—*Athenæum.*

Miscellanea.

WE are pleased to learn that Mr. Charles Welsh, who spent the first seven years of his business career with the late Mr. Henry S. King, has become a member of the well-known firm of Griffith & Farran (henceforth to be styled Griffith, Farran, & Co.), publishers, St. Paul's-churchyard. On the death of Mr. Griffiths in 1877, Mr. Welsh went into the service of the firm, and by his skill, energy, and good judgment contributed very materially to the great extension of business which it has of late years enjoyed.

THE ELECTRICAL RESISTANCE OF ICE.—The resistance of ice has been measured by M. G. Foussereau. He says he determined the resistances of ice made from distilled water by taking for electrodes two thin cylindrical and concentric plates of platinum. He found the resistance became 15,000 times greater at the moment of congelation. The specific resistances varied from 4,865 megs. at − 1° C. to 53,540 megs. at − 17° C. "I found also," he says, "that the resistance of ice varies with the nature of the water from which it is made. A sample of town water 65 times better conductor than the distilled water previously mentioned gave ice conducting 30 or 40 times better."

AXLE BREAKAGES IN GERMANY.—The report of axle breakages in 1883 on the railways in the German Union shows a total of 157, against 181 in the previous year. Of those breaking last year 122 were iron and 35 steel. One of these axles had been running 35 years, three more than 30 years, 10 more than 25 years, and 35 more than 20 years. The average life of those whose age was known was a little less than 15 years. Three of the broken axles were under passenger cars, 100 under freight cars, 35 under tenders, and 19 under locomotives. On the average they had run more than 200,000 miles each. The causes of the breakages are given as follows:—Defects in material, 17; defective manufacture, 2; an old crack which could not be detected, 39; an old crack which could have been detected, 49; collisions, 3; derailment, 1; hot journals, 10; unknown, 36.

SIR RICHARD OWEN'S "History of British Fossil Reptiles," which has been upwards of forty years in preparation, is now at length ready for publication by Messrs. Cassell. On the preparation of the 268 plates with which the volumes are enriched great labour and attention have been lavished. The edition consists of 170 copies only (each copy being signed by Professor Owen), and no further number can be produced, as the plates from which the illustrations have been printed have been destroyed. The publishers are anxious to give an opportunity to the chief libraries of the kingdom of acquiring the work. Among the original subscribers were many distinguished men who are now dead, such as the Prince Consort, the Duke of Buccleuch, the Earl of Derby (the grandfather of the present earl), Sir P. de Malpas Egerton, Sir J. J. Guest (the father of Lord Wimborne), Henry Hallam, Sir Robert Inglis, Sir William Jardine, Professor Lindley, Sir Roderick Murchison, Bishop Wilberforce, Chief Baron Pollock, Professor Sedgwick, Dr. Whewell, Sir F. Thesiger, and Lord Wrottesley.—*Athenæum.*

WEAR OF ENGLISH COINS.—More than eleven thousand pounds sterling worth of silver is wasted every year in the course of the circulation of crowns, half-crowns, florins, shillings, and sixpences. One hundred sovereigns of the date of 1820, which were weighed in 1859 by Mr. Miller, showed a loss in weight through the wear of circulation which was estimated at £1. 6s. 7d. Mr. Miller some years ago made a number of precise experiments, from which it was ascertained that £100 worth of sovereigns lost £3. 9s. 8·4d. of their value in a hundred years. Similarly, £100 worth of half-crowns lost £13. 11s. 8·8d.; £100 worth of shillings, £36. 14s. 3·1d.; and £100 worth of sixpences lost £50. 18s. 9·8d. in value, or more than one-half in the hundred years. It will be noted here with regard to the silver coins that the less the value the greater the amount of wear. These lesser coins are, of course, most used, and so, in the case of a sixpence, a century's wear reduces it to less than half its original value.

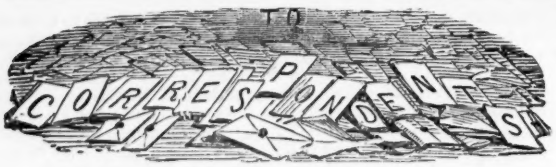
BRAZILIAN DIAMOND MINES.—The diamond beds of Bahia and Minas Geraes, in Brazil, are very similar in character as regards the minerals composing them and their plateau form, or situation on watercourses. A new bed has been recently opened on the Rio Pardo, in Bahia, which presents some differences to those hitherto known in Brazil. The country around is low and marshy, and covered with forests. The working of these forests has led to the discovery of the diamonds, which are found in a white clay along with beds of decomposed leaves. The deposit appears of modern formation. The minerals of the clay accompanying the diamond are, according to M. Gorceux, quartz, silex, monazite, zircon, disthene, staurotede, grenat, almandine, corindon, and some oxides of iron. There are no oxides of titanium, or tourmalines, as is frequently the case in diamond beds. The clay appears to be from its character and situation the debris of the granite mountains bordering on the Bahia coast.

THE ELECTRIC LIGHT IN SOUTH AFRICA.—The Diamond Fields *Advertiser*, in noticing a meeting to be held at Kimberley, for the purpose of deciding as to whether the electric light shall continue in public use or not, says:—"As applied to Kimberley the light has been an unqualified success, and has been a great boon to the inhabitants as regards both the convenience and security of night travelling in and around the town. To how great an extent the safety of our streets has been enhanced it would be difficult to estimate. But some idea may be formed from the fact that outrages are seldom reported, and that the thoroughfares are more free from danger. This has been so marked that it has been well said that each lamp is equal to ten policemen. When fires occur at night, as is most frequently the case, very little looting takes place, because any irregularities of this kind are now so easily detected that gentlemen whose activity would otherwise lead them to secure the goods for their own benefit, instead of trusting to the salvage, do not care to run the risk when the silver rays of an electric lamp are radiating around them. The company has never gone thoroughly into the matter of lighting the mines, theatres, clubs, churches, and private houses, but this could easily be done by the adoption of incandescent lamps, and there can be no doubt but that the results would prove to be of a highly satisfactory nature."

THE PROGRESS OF NEW YORK.—In 1771 the population of the city of New York was a little over 21,000; and in 1786, three years after the close of the revolutionary war, it had 23,614 inhabitants. The several censuses taken during the past 100 years exhibit the marvellously rapid strides which New York has made toward her present imperial position. In 1790, however, the population was little more than it was in 1771; but by 1800 it had risen to 60,515. The remaining censuses are thus given:—1810, 96,373; 1814, 95,518; 1820, 123,706; 1825, 166,086; 1830, 202,589; 1835, 270,089; 1840, 312,710; 1845, 371,223; 1850, 515,547; 1855, 629,906; 1860, 813,669; 1865, 726,384; 1870, 942,292; 1875, 1,041,886; and 1880, 1,206,299. On only two occasions has the enumeration shown a decrease from the figures of the preceding census. The first time was after the war of 1812, and the second after the Civil War. The population of New York city has doubled six times within a century—doubling, on an average, once in every 17 years. In other words, the New York of to-day is 64 times as large as the New York of 100 years ago. The rate of increase in the country at large is insignificant beside that of the metropolis. In 100 years the population of the United States has multiplied itself by 16, but the population of New York has increased at four times that rate. At the rate of increase shown by the last 25 years alone—a rate diminished by the decline of American commerce and the influence of the Civil War—there are children now nursing who will behold a New York city containing no less than 10,000,000 inhabitants.

A RETURN is published containing the gross receipts and the working expenses of the twelve chief railway companies during the first six months of this year, as compared with the corresponding period of last year. The gross receipts of these twelve companies for the whole six months are £25,609,075, a diminution of nearly £20,000 since last year; the working expenses are £13,748,990, an increase of nearly £80,000. The net receipts, therefore, £11,880,985, this year, are less by nearly £100,000 than those of last year. The following six companies show an increase in net receipts since last year:—London and Brighton has increased from £455,193 to £457,289; South-Eastern, from £469,129 to £486,136; Great Eastern, from £673,373 to £746,259; London and South-Western, from £559,295 to £573,012; Lancashire and Yorkshire, from £802,325 to £831,782; Great Northern, from £722,057 to £734,767. On the other hand, six companies have diminished in net receipts. Manchester, Sheffield, and Lincoln, from £459,109 to £441,622; London, Chatham, and Dover, from £242 989 to £242,248; North-Eastern, from £1,594,955 to £1,470,997; Great Western, from £1,875,216 to £1,869,769; Midland, from £1,668,450 to £1,653,882; and London and North-Western, from £2,437,380 to £2,353,222. If now we look to the proportion that working expenses bear to gross receipts, we shall find that this year the expenses of the twelve companies, taken together, have slightly increased from 53·4 to 53·7 per cent. of the gross receipts. If we take each company separately, we shall find the working expenses bear the following proportion to the gross receipts:—Great Northern, 58·9; London and South-Western, 57·7; London, Chatham, and Dover, 57·2; Great Eastern, 55·4; Lancashire and Yorkshire, and London, Brighton, and South Coast, 54·5 each; Midland, 53·4; Manchester, Sheffield, and Lincoln, 53·2; North-Eastern, 51·3; South-Eastern, 52·3; London and North-Western, 52·1; Great Western, 51. In each case the percentage is given.

XUM



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

SHOOTING STARS AND METEORITES.

[1389]—It seems to have been formerly assumed, without inquiry, that shooting stars and meteorites are identical. It is not, therefore, very surprising that subsequent investigators, finding that there were no sufficient grounds for this assumption, should have concluded that they were wholly distinct. This, for instance, is the opinion of the distinguished Astronomer Royal for Ireland, Dr. Ball. It seems to me that this is going too far in the opposite direction, but I rather write to elicit your opinion and that of some of your distinguished correspondents than with a view of expressing a strong opinion of my own. Dr. Ball thinks that the shooting stars which enter our atmosphere are vaporised before they reach the earth. This is probably true of some of them. Others, I should think, from the angle at which they strike our atmosphere, shoot through it without vaporisation (though perhaps heated so as to become luminous), and emerge with little alteration on the other side. But supposing that the shooting star is vaporised, what becomes of it afterwards? It can hardly be supposed to form a permanent addition to our atmosphere, for the heat required to vaporise it will no longer exist after its motion is arrested. The most natural result would seem to be that the vapour thus created should solidify in fine dust (seeing that the vapour must be very rare when generated) and fall on the earth in that condition. And this, perhaps, may be the origin of some of the dust-showers which have been attributed to terrestrial volcanic agency. But though, of course, the vaporisation of the shooting star, as it is called, would increase the resistance to its motion, considering the great speed of these bodies it might fail to arrest it altogether. The vapour might continue to move, get clear of our atmosphere, and solidify again outside of it. In this, however, it is evident that its orbit would be materially altered. The earth's attraction and the resistance of the atmosphere would coerce it to travel in a new course quite distinct from its former one, and in much nearer proximity to our earth. The same observation would apply to a shooting star which had passed through a section of our atmosphere without vaporisation. Its proximity to us and the resistance of the portion of the atmosphere which it encountered would alter its course materially, and even perhaps make the earth rather than the sun the centre round which it moved for the future. This might occur though the star had not actually entered our atmosphere, or had not entered it far enough to become luminous. The shooting stars, whose orbits were thus altered by the earth's attraction, would approach it more closely in their subsequent visits, and their motion would experience further retardation at each collision with the atmosphere; and in this way it seems to me that they might finally drop to the earth without being heated to luminosity at the time of the actual contact. They would, moreover, before this period arrived, cease to be identified with any particular group of shooting stars. They would have wandered so far from the original course of the Leonids, the Perseids, or the Andromedes, to which they had once belonged, that their origin could no longer be distinctly traced. But that genuine shooting stars—highly incandescent bodies—have fallen to the earth at certain times can hardly, I think, be doubted. Thus the "fire-ball" whose course Dr. Ball traces in his treatise on astronomy must, I think, have fallen into the sea not far from the Scilly Isles, and it seems to have presented all the prominent characteristics of a shooting star. Why, then, should we seek for the origin of meteorites in volcanoes on the earth or the moon if shooting stars which have been once brought under the influence of the earth's attraction, and thus diverted from their former orbits, will account for them?

W. H. S. Monck.

BRILLIANT METEOR—SILENT LIGHTNING.

[1390]—On the 3rd of July, 1884, a very brilliant meteor was seen all over eastern Ontario and northern New York. I was at a pic-nic at the time. The sun had set, but there was plenty of light in the sky. The meteor nearly followed the equator from east to west. Its colour was bluish white, and it suddenly burst like a rocket when about 20° above the horizon. It looked so close, that my first impression was that one of our party had let off a fire-work. After bursting, a line of light about 8° long marked the latter part of its track for fully fifteen minutes. It was at first straight, but gradually broke up into a serpentine shape, like so much smoke.

From comparison with its apparent track, as seen at other places, it appears to have passed over the northern part of the State of New York.

Last summer I was travelling in Nebraska and Colorado during very thundery weather, and several times noticed flashes of lightning in clouds almost overhead, without any sound following. On one evening in particular these silent flashes in a cloud at an altitude of about 60° were almost continuous for nearly an hour.

While in Nebraska I witnessed a hailstorm which completely destroyed all the crops over a tract seven miles by two. The stones were the size of large plums, and were driven nearly horizontally by a violent wind. This happened on the evening of a very hot, still day.

Musafir.

DEAN SWIFT AND THE SATELLITES OF MARS.

[1391]—In connection with "Simplex's" quotation from Swift anent the Martian moons, may I be permitted to give a rough version of M. Flammarion's racy comments on the same subject in "Les Terres du Ciel" (Paris: 1884). Having quoted from "Gulliver," as "Simplex" does, the brilliant Frenchman proceeds:—"Here truly is fiction singularly like truth. The prophets of the Bible were never so clear about Christ, and in inspiration Swift is the superior of Daniel and of Jeremiah. Something for weak-kneed theologians to think over. Had some archæologist found an inscription to that effect in the ruins of Egypt or Assyria, those who venerate the past would not fail to have concluded that our ancestors had optical instruments of enormous power. However, it is certain that neither Kepler, nor Swift—nor Voltaire, who writes to the same effect in his delightful "Micromegas"—had seen the Martian moons, and that theirs was merely a happy thought. We, in our turn, might conclude that Uranus had 16 satellites and Neptune 32; but it is likely that here reasoning from analogy would lead us astray from the truth." Arthur Mee.

[In so far as M. Flammarion's argument is directed to showing that the coincidence between the mention of a previously unsuspected fact, and the subsequent discovery of its objective existence, may well be a mere coincidence and nothing more, it is quite legitimate. I protest, however, against one, at least, of his illustrations as irrelevant. To wantonly and offensively attack what has been, and is, held sacred by some of the best and wisest men the world has yet seen, is neither science nor common sense.—Ed.]

FALSE PERSPECTIVE.

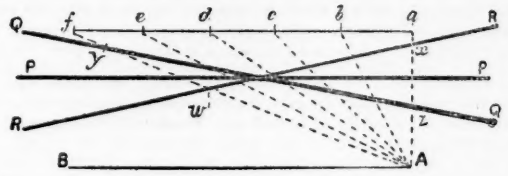
[1392]—I perceive that the rudiments of perspective still engage the attention of your correspondents.

Their opposed views may be grouped into two classes. To one order of minds there appear—firstly, an object; secondly, an eye to see it with; and, thirdly, a mental picture. The physical picture is like Banquo's ghost, not discernible by two people in one place at one time. To the other order of minds there is a fourth factor in the case—namely, a physical picture outside the eye, not at all to be confounded with the mental picture within.

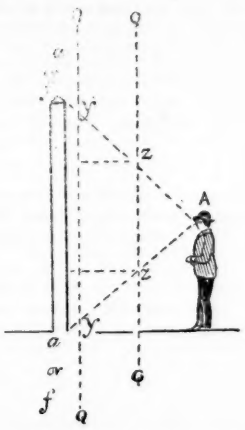
Letter 1359 in your No. 146 illustrates the triple factor system exceedingly well. T. E. (R.) Jones contemplates certain posts as external objects, and acknowledges certain appearances or seemings to the inner consciousness. For instance, he says "the post at *a* will appear taller," &c.; but he has no word to say about the relation of the appearances to the physical picture, considered as a stubborn fact, equally objective and external to the eye, with that other external matter which artists call the subject of the picture.

Your correspondent's strong line A B cannot be the picture, because it does not intercept any lines of light travelling in directions between the posts and the observer at A. Adopting his illustration as regards the posts, I will superadd three different

illustrations of the fourth factor in the case, and its influence. As the upright posts show only as points on the ground-plan, so does the upright plane of the picture show only as a mere line. I will, in the first place, show it at P P; *a*, *b*, *c*, *d*, *e*, and *f* being the posts, and A the observer, agreeably to your correspondent's intention. Under these circumstances former correspondents have already threshed out the subject. I may refer especially to letter 1341, from J. Bacon (KNOWLEDGE No. 142). But other positions Q Q, R R for the plane of the picture will equally answer the condition of intercepting the rays of light *a* to A, and *f* to A.



Let me examine the result of assuming Q Q to be the position of the plane of the picture, with the help of the accompanying vertical section. Here A being the observer, the several posts coincide with another in place on the section; or stated otherwise, the last post, *f*, hides all the others. The several rays of light, A*a*, A*b*, A*c*, &c., on the plan, are shown in section leading from foot and top of



post to A. Set off the distance *a z* from the plan horizontally on the section from the post *a*. This shows the part of the plane of the picture Q Q whereon the post *a* should be drawn. It is at Z Z on the section, being bounded by the rays of light *a* A. Also set off the distance to *y* from the row of posts as obtained from the ground-plan upon the section. This gives us at *y y* the length upon the plane of the picture which will be occupied by the image of the post *f*. Thus, with the assumption of a plane of the picture P P in parallel perspective (as in letter 1341) the posts should be drawn of equal height; 2ndly, with the assumption of Q Q as the place of the plane of the picture, the post *f* should be drawn as at *y y*, much longer than the image *z z* of the nearer post; and, 3rdly, it would be equally easy to show that with the assumption of R R as the place of the plane of the picture, the image of the further post *f*, at *x* in R R, would be shorter than the image of the nearer post *a*, at *x* in R R. The results of this third assumption alone agree with the three impressions of your latest correspondent. I cannot dispute the impressions on his inner consciousness; I am only showing the geometry of a drawing to be placed outside the physical eye. AN OLD DRAUGHTSMAN.

LIFE.

[1393]—Reading in the *Times* of Sept. 2 the Rev. W. H. Dallinger's lecture on Life, I am tempted to ask him why, like Tyndall, he is unwilling to go beyond no life without antecedent life, and therefore close the door to further inquiry? The object of science is to discover (if possible) the origin of all things our senses can take cognizance of, the elements out of which all matter is built up, and, in my opinion, something that at present the human senses are unable to take cognizance of, inasmuch as hey are only to be found in what we call space, immediately they are subjected to *any* influences. They love their elemental condition, and form combinations out of which all things are built up.

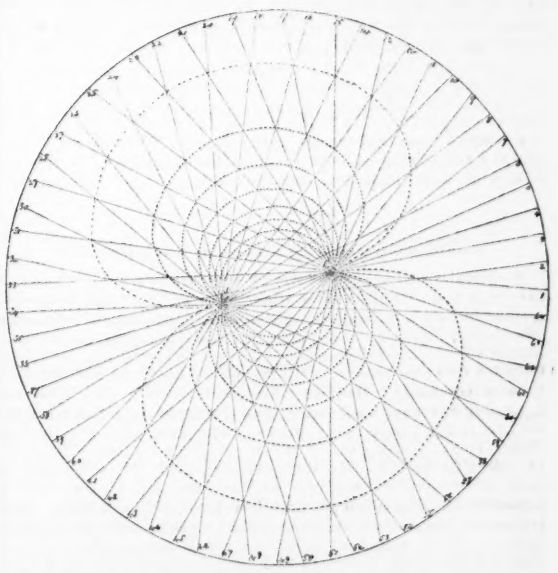
I once before ventured to suggest the origin of the vital spark, and I should like to ask the Rev. W. H. D. if any violence is done to the principle of evolution by asserting that there is a moment of time when the substance of conception springs into animation. I therefore take it that there is no necessity to ask for matter, other than that we already know of, but have only to investigate the special condition of matter out of which life springs.

A NON-Y. Z.

THE CURVES ON A BICYCLE WHEEL.

[1394]—An interesting optical effect may be observed by anyone with ordinarily good sight who watches a bicycle passing rapidly by him. Looking carefully at the driving-wheel as it approaches, he will see a number of shadowy curves above and below the axle. These change their figures slowly until the instant of passing, when they shift position suddenly, and again gradually alter as the machines recedes. The *rationale* of these curves seems to be that they are the optical effect of the apparent intersections of the spokes, the appearance being rendered continuous by the rapid rotation of the wheel. The spokes of a bicycle, it will be remembered, are not, like those of an ordinary carriage wheel, carried out to the circumference from a central point, but spring alternately from drums at opposite sides of its plane, thus forming a cage of two cones base to base.

When the eye is situated anywhere except in the plane of the wheel, or the line of the axle, the two sets of spokes appear to intersect, each spoke from the nearer drum crossing (in general) a number of the spokes which spring from the remoter drum.* If the spokes are numbered consecutively round the circumference of the wheel, all the odd numbers belong to one drum and all the even numbers to the other. The intersections nearest to the circumference are those of consecutive spokes, and it will be found, on plotting down their points of intersection, that they all lie on two loops, one above, the other below, the axle, and both springing sharply from the two drums. In like manner, the intersections of each spoke with the third in order from it (1 and 4, 3 and 6, 5 and 8, &c.) determine two loops which lie entirely within those first mentioned. The intersections of spokes separated by four (1 and 6, 3 and 8, &c.), give rise to the third pair of curves, and so on, until when the intersecting spokes are widely separated the number of intersections in either semicircle



will be too small to define the form of the curve. Now the manner in which the rotation of the wheel helps to make these curves optically continuous seems to be as follows:—When the wheel

* It will be easily seen that, although two sets of n lines intersect in n^2 points, when the lines proceed from fixed points, and are not produced beyond those points, the number of actual intersections cannot exceed $\frac{n^2}{4}$, however large may be the wheel.

revolves, each pair of spokes is brought into the position occupied an instant before by another pair. If, then, the intersection of two spokes gives rise to *any* appearance, the revolution of the wheel will cause that appearance to become a continuous curved line. The effect of the apparent intersection is, of course, to shut out from sight a portion of the further spoke; and, if the edge of the latter be brightly illuminated, this occasions a very definite optical effect. It is to this eclipse of the bright edge of the remoter spokes that these optical curves must be ascribed.

The mathematical investigation of these curves is not without interest, and will afford a useful exercise to the student who desires to find the equation. We shall not enter into the details of the work, but merely indicate some of the results at which we have arrived.

Considering the visible appearance as projected on the vertical plane, it will be found that the curves traced on that plane are of the fourth degree, that they are divided into two loops by the perspective trace of the axle (which accounts for the change of position as the machine passes the eye), and that the projections of the two points from which the spokes spring are singular points on the curves. Lastly, any curve of the system may be generated as follows:—Given a point, a line, and a circle, the curve is the locus of a point such that the product of its distances from the point and line bears a constant ratio to the square of the tangent drawn to the circle.

A. St. John Clerke.

THE WICKED FLEA.

[1395]—To exterminate the pestilence that walketh as well as the one that hoppeth by night, I have found nothing so efficacious as to pepper the mattress finely with dry bleaching powder, which is best carried in a bottle. Take care not to let any stay in lumps, as it rots clothes.

City Bee.

PARKGATE.

[1396]—Having lived at Parkgate for over two years, I beg to doubt Mr. Percy Russell's opinion (expressed in Knowledge No. 147) as to the fitness of the estuary for a haven for commercial fleets. Half-way across there is a large sandbank, which very, in fact most, often is not covered by the tide, and consequently a fishing-boat left in its neighbourhood is perfectly safe without an anchor.

Parkgate now is far from being a watering-place, or competing as such. The cause of its decay is, I believe, twofold—(1), that the channel of the Dee has changed from the Parkgate to the Welsh side of the estuary. (2) The obnoxious smells coming across the river from the Kent chemical works. Parkgate, however, has its attractions, and nothing could be pleasanter than a night's shrimp-fishing in Bill Smith's boat round Hilbury Island, and never were shrimps so good as those fresh from the boiling-pot on deck.

Certainly, Parkgate, from a picturesque point of view, is unique, and the old adage, "All on one side, like Parkgate," is literally true, even down to the curious railway-station.

F. W. T.

LETTERS RECEIVED AND SHORT ANSWERS.

F. Cowley.—Your request almost amounts to one that I should give you the catalogue of a small library. You had better get Doctor Brewer's "Reader's Handbook," Lemprière's "Classical Dictionary," Bohn's "Dictionary of Classical Quotations," Todhunter's books on Trigonometry and the Differential and Integral Calculus (see also lessons on the former in these columns), Cassell's "Latin Grammar," Delille's "French Grammar," &c. How can I possibly tell what book Mr. George Augustus Sala recommends?—Captain D. Forbes. Many thanks; utilised elsewhere.—Scientist. There is no such thing as an "art of writing with special reference to scientific work." My own experience of the caligraphy of men of science induces me to imagine that it ranges from moderate badness down to practical illegibility.—Berks. Your informant was either a knave or a fool; most probably the latter.—Quidam. Every discovery of an additional three weeks' supply of coal in this country possesses both popular and scientific importance, in view of the fact that the total amount of coal-bearing strata beneath these islands is limited.—Ne Sutor ultra Crepidam. What a pity you don't take your own motto to heart. I congratulate you on your champion. Were I to print the author's name, even you might admit that he requires no instruction in the subject you refer to.—G. W. N. "Popularising Astronomy" is a subject with which certainly more than one member of our staff is competent to deal.—Charles Froebel. Much too metaphysical for these columns.—Vega. Jevon's "Elementary Lessons in Logic," and "Studies in Deductive Logic," both published by Macmillan & Co., ought to suit you. The best *small* volume on elementary geology is Page's "Advanced Text-Book," published by Blackwood.—Arcturus. Kindly consult Vol. IV. of Knowledge, pp. 68, 84, 100, 116, and 139.—Harold Rowntree proposes to get to the North Pole of the earth by submarine navigation. I presume that Mr. Rowntree is aware that icebergs have been seen rising between 200 ft. and 300 ft. above the sea, and that something like eight times their visible mass must have been submerged. Has he provided against running into the base of one of these stupendous floating islands? He will explain the design of his vessel to any one who may care for such explanation.—Faciebat. M. Mouchot ought to win one of the *Tit-Bits* prizes. I have not read Mr. J.'s article, and your extract is not too intelligible in the absence of the context; but, of course, the tremulous motion of objects in landscape, viewed in blazing sunshine, is more perceptible in the distance, because they are seen through a long stratum of heated air. Every ray of the sun which reaches the earth brings actinic power with it.—H. W. Parr. See paragraph at the bottom of col. 1, p. 62.—R. G. Your coincidence is of much too commonplace a character to justify me in occupying space with it.—George S. Gibbs. I cannot reprint letters to other journals.—Lerryn. Professor Clifford died at Madeira on March 3, 1879. It is absolutely and utterly false that he joined the Church of Rome before his death. See pp. 24, 25, and 26 of Vol. I. of his "Lectures and Essays," published by Macmillan.—Nemo. There is a table of semidiurnal arcs in Chambers's "Mathematical Tables," by the aid of which the approximate time of rising may be found of any star whose declination and time of southing are given.—H. B. L. The proceedings of the Learned Societies are practically all purchasable by the public, though, as a rule, not in numbers, but in volumes. Single numbers, however, of the Journal of the Royal Microscopical Society may be bought at Williams & Norgate's, and volumes of the R.A.S. "Monthly Notices" of the same publishers. I do not know the name of the publishers of the Geological or Linnæan Society's transactions.—A Well-Wisher (Burra-Burra, S.A.). Without reprinting an entire paragraph verbatim here, I may mention that what Mr. Jago says is, that alum possesses the power of arresting the action of the gluten of damp flour on its starch, prevents the decomposition of starch, and bread from becoming sour or mouldy. Your complaint about numbers forwarded to the publishers. Thanks for friendly expressions.—Algernon Bray points out that the mere labour of the production of a magic cube is less than is supposed (especially when the root is a prime number). Letter forwarded.—H. A. B. The book from which you quote is a mere compilation, destitute of the slightest scientific authority. The difficulty about the Equation of Time seems wholly of your own creation. On November 2 in this year the Sun will south in London at 11h. 43m. 41s. a.m., as shown by a clock indicating Greenwich mean-time, and will set there at 4h. 29m. p.m., as shown by the same clock.—Commentator. Oh, good gracious! It is related that after a Devonshire parson had stated in a sermon that Commentators did not agree with him, a farmer waited on him with a present of a basketful of potatoes, saying, that as his spiritual pastor had intimated "that common 'taturs didn't agree with him, he had brought him a basket of his best kidneys, which he hoped he would find more wholesome." I am a little afraid that the readers of Knowledge would cry out for something "more wholesome" after the few columns into which your communication would print.—W. Hepworth Collins. The writer of the letter of which you enclose a cutting is not responsible for his actions, and to print it would do him more harm than good.—John W. Staniforth is exercised about the dynamics of a briar-root pipe; which, floating on the sea about half-a-dozen yards from the shore, of course bowl upwards, remained sensibly in one spot, and for a quarter of an hour rotated from east to west about north round its stem as an axis. Its moment of inertia would of course operate in rendering the direction of its motion persistent.—Dr. E. South. I cannot say off-hand who was the first person to point out the unsoundness of Olbers's idea, but each fresh discovery of an asteroid, and the manner in which they are grouped, adds to the accumulated mass of proof that they can never have been united in a single body. Are you aware that the nodes of their orbits lie in all parts of the ecliptic?—Arnold T. Reed. Professor Jevons was entirely correct; the moon's (so-called) "changes" have *nothing* to do with the weather in any shape or way. If the "marble" is composed of carbonate of lime, it will attract the lime in the water to itself, for a pretty obvious chemical reason. The best book on electrical measurement, at a moderate price, is "Kempe's "Handbook of Electrical Testing."—A. G. White. I do not myself know the Table of Pythagoras, and am many miles from a copy of Peacock's "History of Arithmetic," in the *Encyclopædia Metropolitana*, the likeliest place to find an account of it.

Our Whist Column.

By Five of Clubs.

THE LAST TRICKS.

SKILL at Whist is chiefly shown as the last few tricks are made. The steady conduct of the hand according to sound principles, and with careful attention to the fall of the cards, leads to a satisfactory (or the best available) position at the close, and the attentive player can usually tell precisely what that position is. But to take advantage of good points in the position, or to avoid threatened loss, requires other qualities than (as a rule) have been sufficient for the earlier conduct of the hand. The play is now like that of a double-dummy game. Only a trick or so may perhaps depend on correct strategy at this stage; but a game or a rubber may depend on that trick.

The chief points arising at the close of a game are these:—(1) The right of choice of cards to throw away to winning cards either of the enemy or of your partner; (2) placing the lead; and (3) what may be regarded as a combination of both points, the recognition of the necessity which sometimes arises for throwing away a winning card or an extra trump—playing what is called (after Deschapelles) the *grand coup*.

Necessity for care in choosing the right card or cards to throw away to tricks won by partner or the adversaries, may arise in several ways, and a case of this kind may be simple or difficult according to circumstances. Thus you have a card which would be a certain winning card if you had to lead it, which yet is of no value to you because the suit is certain not to be led. In this case you throw it away without hesitation. Again you may have to choose between throwing away a trump (to a suit already trumped higher by the enemy) or a certain or possible winning card in a plain suit, yet though this seems like the *grand coup* the question may be one of extreme simplicity, from the consideration that the trump will certainly be of no use to you (being at once drawn by the enemy if retained) while the good plain-suit card may take a trick. Again the choice between two good cards to throw away may be a little more difficult, because you may be in doubt which of the two suits will be eventually led; or of two second-best cards, you may doubt which to throw because while you are certain that one or other of the best cards to those suits must be discarded by the enemy you cannot tell which it will be. Or lastly, the question may be of discarding guarding cards, and you may be in doubt which of two suits must be most carefully guarded.

It is impossible to lay down rules here, since each case must be dealt with as it arises, and the number of cases is legion. Nothing but great care and attention can save you from losing tricks at the end of several of the hands played in the course of an evening by discarding from the wrong suit. But when, by carefully following the fall of the cards, you know where the command in each suit lies, and also where small cards which will have to be led are situate, you generally have a tolerably easy problem towards the end of the game, in selecting which cards to throw away and which to retain.

Skill in throwing the lead is akin to Whist memory, in that it comes to be instructive with practice. A good player feels, when he holds a major tenace, for example, that he must throw the lead so that the holder of second best guarded shall have to play before him; while when the major tenace is against him he feels, without any occasion for thinking about it, that the holder of that tenace must, if possible, be made to play before him.

There are often simple cases of throwing the lead, in which, nevertheless, the average player frequently blunders, if not on every occasion which arises:—Thus leader holds the major tenace and a small card against the minor tenace and a small card, in trumps or in a plain suit after trumps are extracted. In nine cases out of ten the average player, even though he has seen enough to know how the matter stands, leads nevertheless the best card, transferring the adversary's minor tenace into major tenace, through which he has to lead, losing therefore both the remaining tricks. It is so obvious that in such a position the small card should be led, that it seems hardly worth while to notice the point; yet we see tricks lost in this way repeatedly; of course, by leading a small one, even though the trick may be made by the adversary's small one, yet as he has to lead from his minor tenace you make two tricks.

One sometimes hears a weak player explain that he could not lead a particular card because he knew an adversary would take the trick, though this may be just what he should have done to save the game. You know, suppose, that the player to your left has the winning Spade, the second best and two small Clubs, you holding a small Heart, the major tenace in Clubs, and a small Spade (trumps all out); you know, further, that your partner has the best Heart and three small Clubs, the adversary to your right having only small cards, so that he can get no lead. You want three tricks to save or to win the game. Under these circumstances if you lead a Heart, your partner makes a trick in Hearts, and must then lead a Club through your tenace; you make a trick in Clubs, and the remaining two tricks go to the enemy. But now suppose that you had led a Spade. Your adversary to the left takes the trick, by which you lose nothing, as he must have taken it anyhow. But now he has to lead a Club; and, however he leads, you make two tricks in Clubs, lead your small Heart, and give a third trick to your partner.

The *grand coup* consists in throwing away a trump or a winning card in order that you may not escape a lead, where leading would lose you a trick. Suppose for instance in the case just considered, that your opponent to the left either knew his partner had the second best Spade, or else that the game could not be saved unless he had that card. Then if before the ninth trick he had thrown away his winning Spade, retaining say a small Heart or Club—it matters not which—he would have played the *grand coup*, saving the game if his partner *could* make the Spade trick, and in any case taking the only course to save it. For now, if you lead the Spade and the trick falls to opponent on your left, then whether he leads a Club or a Heart your tenace in Clubs must be led through, and the guarded second best Club on your left must make another trick. Even if it so turns out that you yourself have the best Spade after your opponent on the left has discarded his winning one, he loses nothing. He makes a trick in Clubs, anyhow.

Put yourself in his position, and see how the *grand coup* in this case comes to be played:—

B holds

Diam.—3. Clubs—5, 4, 2. Hearts Q.

Y holds { Clubs—Kn, 7, 3; Hearts—5; Spades—Q }

Z holds { *Diam.*—Kn; Clubs—6; Hearts—6, 3; Spades—9 *or* 8. }

A holds

Diam.—Q. Clubs—Q, 9. Hearts—4. Spades—8 *or* 9.

You are Y; Diamonds are trumps; *A* leads Diamond Q; and you know how the above cards lie, all but the position of the Eight and Nine of Spades. How shall you play? If you discard Heart Five, or Club Three, *A* leads his small Spade, you make the trick, and make no more. If on the contrary you discard the winning Spade, then, however *A* plays, your Club Knave will eventually make, so that you have lost nothing; while if *A* holds the smaller Spade of the two left, you gain a trick, and your partner wins the trick, (since *A* cannot escape leading his Spade).

The *grand coup* is commonly understood to mean the throwing away of a useless trump, either by under-trumping your partner, or by trumping a trick which he has already won. If you have the major tenace and a small card in trumps, and a plain card (winning or not), while your right-hand adversary has the minor tenace only, or the second best guarded in trumps, the possession of that small trump may force you to lead from your major tenace, in which case, of course, the adversary will make a trick. But if you can part with that small trump, without losing a trick in doing so, your tenace will be lead up to, and every trick be made.

The games which have appeared in past numbers of KNOWLEDGE illustrate many interesting cases of end-play, coups, &c.

*** The instructions for play which have appeared in past numbers of KNOWLEDGE will shortly be published in book-form for reference; and hereafter about two games monthly will be published in these columns.

THE MOSQUITO'S INSTRUMENT OF TORTURE.—It appears that in the "bill" of the little beast alone there are no fewer than five distinct surgical instruments. These are described as a lance, two neat saws, a suction-pump, and a small Corliss engine. It appears that when a "skeeter" settles down to his work upon a nice tender portion of the human frame, the lance is first pushed into the flesh, then the two saws, placed back to back, begin to work up and down to enlarge the hole, then the pump is inserted, and the victim's blood is siphoned up to the reservoirs carried behind, and finally, to complete the cruelty of the performance, the wretch drops a quantity of poison into the wound to keep it irritated. Then the diminutive fiend takes a fly around just to digest your gore, and makes tracks for a fresh victim, or if the first has been of unusual good quality he returns to the same happy hunting-ground. The mosquito's marvellous energy, combined with his portable operating chest, make him at once a terror and a pest.—*Sportsman.*

XUM

Our Chess Column.

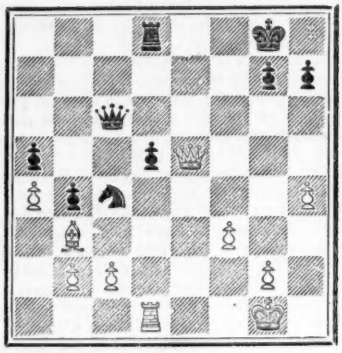
By Mephisto.

PROBLEM No. 127.

Ending from Actual Play.

Amateur.

Black.



White.

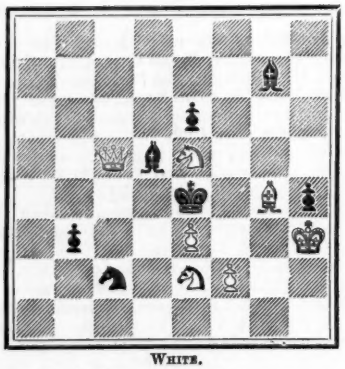
Mr. Robey.

White to play and win.

No. 128.

By Clarence.

Black.



White.

White to play and mate in two moves.

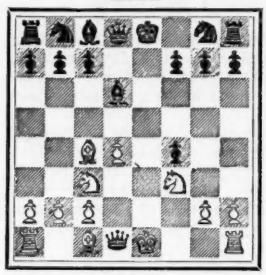
GAMBIT DECLINED.

Of all the openings the Gambits lead to the most lively games. By advancing 2. P to KB4, on the second move, White temporarily abandons this P, but he is compensated for the sacrifice by obtaining a speedy development of his pieces, and a correspondingly strong attack. It is undoubtedly true that, both for recreation and study, Gambits are invaluable sources of enjoyment and instruction. Nevertheless, occasions may occur when it will be found desirable to decline the Gambit, as that course undoubtedly leads to a safer and easier line of play; as, for example, when meeting a stronger player or when receiving odds. In the latter case, especially, it is desirable to avoid Gambits, for, as we have shown some time ago, it is positively suicidal to accept certain Gambits when receiving the odds of QKt.

After 1. P to K4, P to K4, 2. P to KB4, Black can decline the Gambit by playing 2. P to Q4 at once, or as follows:—2. P × P. 3. Kt to KB3, P to Q4. White would not gain any advantage by playing 4. P to K5, as Black could defend his P by P to KKt4, and White could never bring the KB to bear upon KB7, the chief support of the Gambit attack. If, on the other hand, 4. P × P, Black can now play 4. B to Q3, which will give him an even and safe game, or he may play 4. Q × P. 5. Kt to B3. Here the tyro is exposed to a danger which he ought to know, in order to be able to avoid it. If now 5. Q to K3 (ch), K to B2, White now threatens to win the Q by playing B to Kt5 (ch), followed by R to K sq. Black, of course, can prevent this by playing B to Q2 or Q to Kt3, but in either case he will have a difficult game to play, while White will soon bring his R to K sq. and K to Kt sq. Instead of the (ch) with the Q after 5. Kt to B3, Black will do better to reply with 5, Q to Q sq. Whatever White does, Black ought to be able to hold his own. If 6. P to Q4, B to Q3, 6. B to B4.

The position now requires a little attention. Of course, 6. Q to K2 (ch) for Black would not be good, on account of K to B2 threatening R to K sq., or if 6. Kt to B3, then 7. Q to K2 (ch), if Q interferes. White takes the Black Q, compelling the K to retake, with an unfavourable position. 6. Kt to K2 would be worse still, for White would immediately play 7. Kt to K5, Castles. 8. Q to R5, with a won game. But Black may play 6. P to KR3. 7. Castles, Kt to K2. 8. Kt to K2, P to KKt4, with a good game.

Black.



White.

Although this is, in reality, an accepted Gambit, yet it avoids all the well-known Gambit attacks, and Black plays P to KKt4 under more favourable conditions. Black must now seek to develop his game; for that purpose the following moves may serve:—B to KKt5, P to QB4, Q to Kt3, &c. Castling on the Q's side would give Black a great advantage.

(To be continued.)

Through Farringdon-street Junction of the Metropolitan Railway 1,800 trains pass in twenty-three hours every day. There are four lines of rails, used by the Metropolitan, Great Northern, Midland, London, Chatham, and Dover, and Metropolitan Extension Companies. The total number of passengers conveyed over our railways in 1883, exclusive of season-ticket holders, was—first-class, 36,387,177; second-class, 66,096,784; third-class, 581,233,476; total, 683,718,137; and season-ticket holders, 180,000,000. Of minerals there were conveyed 189,485,612 tons; of general merchandise, 76,897,356 tons; number of miles run by passenger trains, 139,545,464; number of miles run by goods and mineral trains, 129,351,774; total miles run, 268,897,236; miles of railways, 18,668; number of persons employed, 367,660.

Contents of No. 149.

	Page
Our Two Brains. By Richard A. Proctor	189
Dreams. VIII. By Edward Clodd	190
The Westinghouse Brake. By "Trevithick"	192
More About Sunflowers. By Grant Allen	193
The Earth's Shape and Motions: IV. Determining the Shape of the Earth (*Illus.*) By R. A. Proctor	194
An Address to the British Association.	196
The Electric Light in the Mechernich Mines	197
Optical Recreation. (*Illus.*) By F.R.A.S.	198
How American Carp are Destroyed. (*Illus.*)	199
Other Worlds than Ours. By M. de Fontenelle. With Notes by Richard A. Proctor	200
Muscular Contraction after Death	201
International Health Exhibition. XIII. (*Illus.*)	202
Editorial Gossip	203
Reviews	204
Miscellanea	205
Correspondence	205
Our Chess Column	208

NOTICES.

Part XXXIV. (August, 1884), now ready, price 1s. 3d., post-free, 1s. 6d.

Volume V., comprising the numbers published from January to June, 1884, now ready, price 9s., including parcels postage, 9s. 6d.

Binding Cases for all the Volumes published are to be had, price 2s. each, including parcel postage, 2s. 3d.

Subscribers' numbers bound (including title, index, and case) for 3s. each Volume; including return journey per parcels post, 3s. 9d.

Remittances should in every case accompany parcels for binding.

TERMS OF SUBSCRIPTION.

The terms of Annual Subscription to the weekly numbers of Knowledge are as follows:—

	s.	d.
To any address in the United Kingdom	15	2
To the Continent, Australia, New Zealand, South Africa, & Canada	17	4
To the United States of America	$4.25 or 17	4
To the East Indies, China, &c. (*vid* Brindisi)	19	6

All subscriptions are payable in advance.

OFFICE: 74-76, GREAT QUEEN STREET, LONDON, W.C.